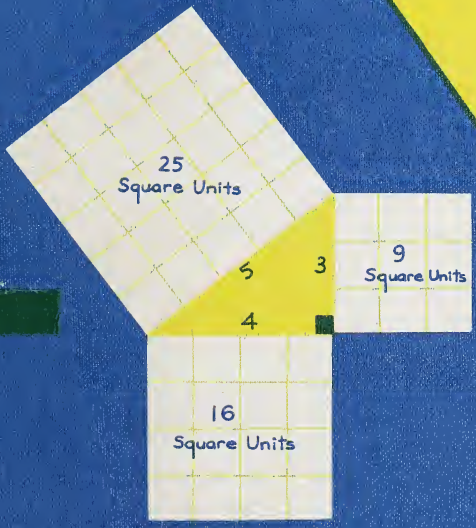
WINSTON MATHEMATICS

Intermediate

Book 2



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Intermediate 2

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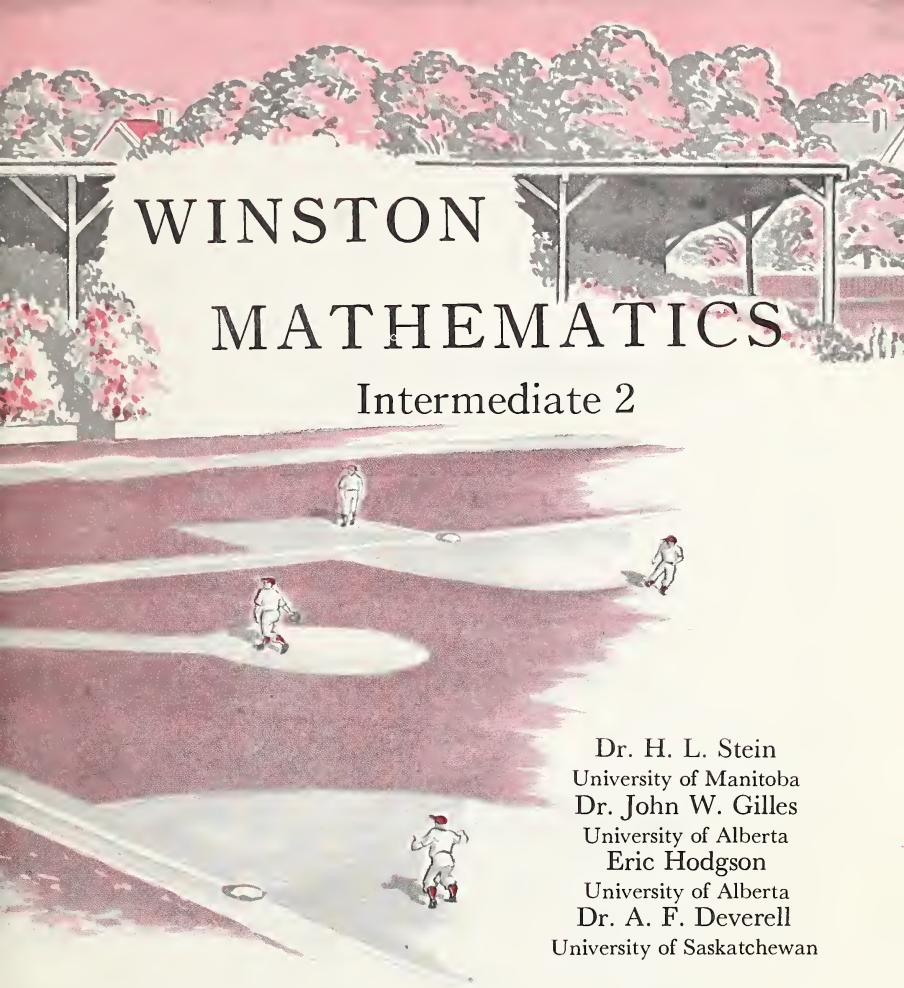

WINSTON MATHEMATICS

Intermediate 2

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WINSTON MATHEMATICS

Intermediate 1

Intermediate 2

Functional Mathematics

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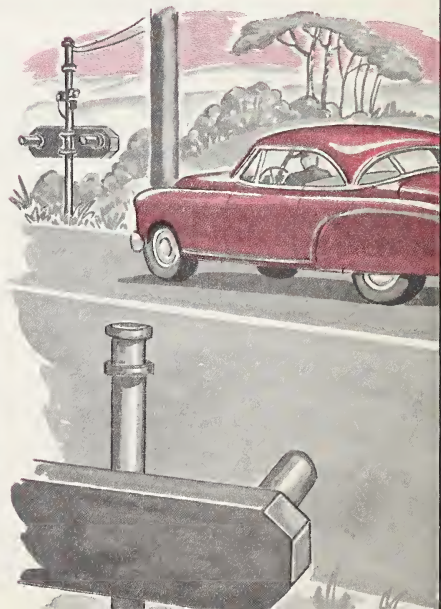


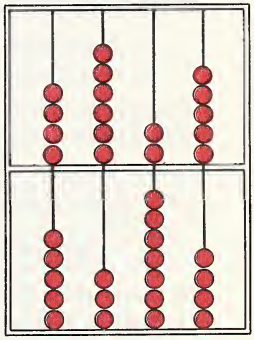
CHAPTER I

How Many?

Man has always needed to know how to answer the question, "How many?" The pictures on the facing page show some of the means used in the past and at present to answer this question.

In ancient times shepherds used pebbles as counters, one pebble for each sheep. This method of answering the question, "How many?" is called **matching**. In order to match, it is not necessary to be able to count.

1. If the shepherd in ancient times could not count, how could he find out if some sheep were missing?



2. The picture on the right shows an **abacus**. An abacus is a frame containing rods on which there are movable beads. Each bead on a rod represents one for the **place** the rod holds in a number. The first rod on the right of an abacus represents ones' or units' place. The second rod represents tens. Which place does the third rod represent? What number is represented on the abacus?

3. How many beads are there on each rod of the abacus?

4. On the abacus shown, how is it possible to represent 100? to represent 1000?

5. The man in the third picture has a counter, about the size of a pocket watch, on which there is a dial like the part of a speedometer that registers mileage. Each time a car passes him, he presses the stem on the counter and the number in the dial increases by one. If the dial will register four-place numbers, as 1125, what is the greatest number that can be registered? the smallest four-place number?

6. The "electric eye" shown is an electrically operated instrument which records the cars as they pass a given point. Which of the ways shown do you think is the fastest method of counting? Which is least accurate?

Picturing Our Number System

Each of the pockets in the place-value chart represents a **place** in which a figure may be written in a number. In 38 the 3 is in tens' place and the 8 is in ones' place. Find the pockets which represent these places in the chart.

1. The place-value pockets show how we group numbers. What is the name of each group shown to the left of hundreds' place?

2. How many pockets or places are there in each group?

3. The 2 cards in the first pocket on the right in the group of **thousands** represent 2000. How many cards should there be in this pocket to represent 9000?

4. If there were 2 cards in the second pocket in the group of **thousands,** these cards would represent 20,000. What number would 5 cards in this pocket represent?

5. If there were 2 cards in the pocket on the left in the group of **thousands,** these 2 cards would represent 200,000. What would 7 cards in this pocket represent?

6. What number would one card represent if it were in the first pocket on the right in the group of **millions**? in the pocket on the left in this group? Write these numbers with figures.

7. Where can we place 4 cards in the pockets of the place-value chart in order to represent 4 million? 40 million? 400 million?

8. How many thousands make a million? a billion?

9. How many millions make a billion?

10. If the place-value pockets showed one more group on the left, the name of this group would be **trillions.** How many billions are there in a trillion? How many millions are there in a trillion?

★11. Tom studied the chart and said, "Ones, tens, and hundreds are repeated in different groups beginning with thousands to form different places in our number system." Is Tom correct?

How Well Do You Understand the Number System?

Your answers to the following questions will show how well you understand our number system.

1. In the number 362,058, which figure is in thousands' place? Which figure is in hundreds' place? Which figure is in ten-thousands' place?

2. In the number in problem 1, give the value of the 3; of the 2.

3. In the number in problem 1, which figure has the greatest value?

4. What is the value of the 3 in 3270? of the 3 in 430?

5. The value of the 3 in 3951 is how many times as great as the value of the 3 in 236?

6. The value of the 3 in 236 is what fractional part of the value of the 3 in 3951?

7. How many places to the left of ones' place is thousands' place?

8. In a certain number, the figure 4 is five places to the left of ones' place. What value does this 4 have?

9. Show that 560 is 56 tens; that 3800 is 38 hundreds.

10. How many tens are there in 960? in 3410?

11. How many hundreds are there in 72,500? in 234,500?

12. How many tens are there in a thousand? in one hundred thousand?

13. How many hundreds are there in a thousand?

14. Using the digits (figures) 1, 2, 3, and 5 only once, write the largest number possible in which 3 is in tens' place.

15. Find the difference between the largest and smallest whole numbers which may be made with the same four digits used in problem 14.

16. If we annex a zero to both numbers in the example on the right, by what number will the product be multiplied?

$$\begin{array}{r} 38 \\ \times 7 \\ \hline \end{array}$$

17. If we annex a zero to both numbers in the example on the left, what effect will this have on the quotient?

$16\overline{)48}$

How We Round Off Numbers

The number on the left shows the population of this country according to the 1951 census. The number on the right shows how we **round off** this number to understand it better. This number is an **approximate** amount, correct to the nearest million.

1. Round off 425 and 460 to the nearest hundred.

   425 to the nearest hundred is 400; 460 to the nearest hundred is 500. When a number is rounded off to the nearest 100, any number below 50 is dropped and the numbers 50 to 99 are regarded as the next hundred.

2. Round off 8540 to the nearest hundred; nearest thousand.

   8540 to the nearest hundred is 8500; 8540 to the nearest thousand is 9000. Explain.

3. Make a rule for rounding off a number.

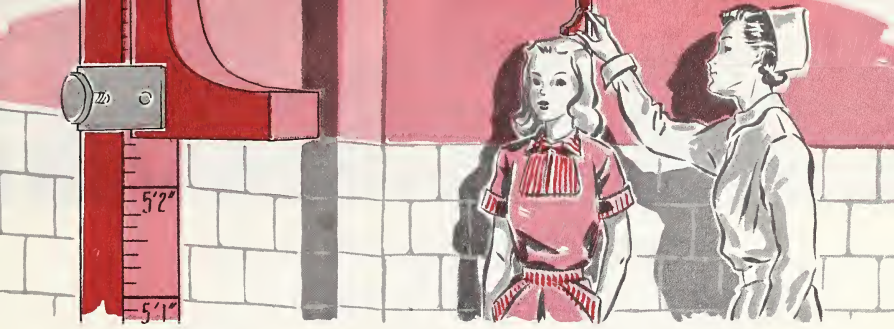
4. Round these numbers off to the nearest thousand; then to the nearest ten thousand.

a. 172,450	c. 104,499	e. 625,380	g. 360,450
b. 435,620	d. 299,500	f. 754,990	h. 149,900

5. A whole number rounded off to the nearest thousand was 5000. Before the number was rounded off, the greatest value this number could have had was 5499. What was the least value this number could have had?

6. Each of the following whole numbers is rounded off to the nearest thousand. Give the greatest and least values each number could have had before it was rounded off.

a. 7000 b. 12,000 c. 1000 d. 30,000 e. 100,000



No Measurement Is Ever Exact

The school nurse is measuring Dorothy's height. The nurse keeps a record, to the nearest half inch, of the height of each pupil.

1. Dorothy's height is slightly more than 5 ft. 2 in., but less than 5 ft. $2\frac{1}{2}$ in. Is the bar on the scale showing the height nearer to the 2-inch mark or to the $2\frac{1}{2}$-inch mark?

2. The nurse recorded Dorothy's height as 5 ft. $2\frac{1}{2}$ in. Why was it not called 5 ft. 2 in.?

3. If the bar had been closer to the 2-inch mark than to the $2\frac{1}{2}$-inch mark, how would the height have been recorded?

4. If the bar is just midway between the 2-inch mark and the $2\frac{1}{2}$-inch mark, the height should be recorded as $2\frac{1}{2}$ inches. Why?

5. State a rule for rounding off a measurement to the nearest inch; to the nearest half inch.

6. Round off the following measurements to the nearest inch; to the nearest half inch.

a. $7\frac{3}{8}$ in.	c. $1\frac{1}{4}$ in.	e. $4\frac{3}{4}$ in.	★g. $\frac{9}{16}$ in.
b. $\frac{5}{8}$ in.	d. $2\frac{7}{8}$ in.	f. $6\frac{1}{8}$ in.	★h. $1\frac{5}{16}$ in.

7. Jack's height, to the nearest inch, is 65 inches. His true height must be between what two numbers?

★8. Find the length of your desk to the nearest inch; to the nearest half inch.

★9. Find the height of one or more of your classmates to the nearest inch; to the nearest half inch.

★10. Tell why the heading of this page is correct.

Checking on What You Have Learned

Let us see how well you remember the work of last year.

	Whole Numbers		Fractions		Decimals	
I. Addition						
1.	730 425 608 927 546	2. 906 58 1342 457 89	3. $6\frac{1}{2}$ $2\frac{1}{4}$ $3\frac{5}{8}$ $1\frac{3}{4}$	4. $9\frac{1}{2}$ $2\frac{5}{6}$ $4\frac{1}{3}$ $1\frac{2}{3}$	5. .72 .38 .46 .55	6. 1.4 3.8 7.5 0.9
II. Subtraction						
1.	7304 6409	2. 24,012 4,035	3. $5\frac{1}{2}$ $3\frac{3}{4}$	4. $8\frac{1}{3}$ $7\frac{5}{6}$	5. .735 .445	6. 4.15 3.87
III. Multiplication						
1.	876 9	2. 437 308	3. $\frac{3}{4} \times 1\frac{7}{8} =$ 4. $1\frac{1}{2} \times 2\frac{2}{3} =$		5. 4.5 1.2	6. .24 .3
IV. Division						
1.	$7\overline{)4112}$		3. $\frac{5}{6} \div \frac{3}{8} =$		5. $.4\overline{)5}$	7. $8\overline{)1}$
2.	$17\overline{)9012}$		4. $1\frac{1}{2} \div 3 =$		6. $.1\overline{)9}$	8. $4\overline{).7}$

V. Per Cent of Whole Numbers

1. 3% of 180 =
2. 5 = ?% of 25
3. 120% of 450 =
4. 15 = ?% of 12
5. 15% of 270 =
6. 17 = ?% of 17

If you made errors in any of the processes in whole numbers, take the diagnostic tests in those processes. Do the same for fractions and decimals. The directions on page 7 will show where to find the Study Helps and which diagnostic tests to use.

Where to Find Diagnostic Tests

Diagnostic tests help you to discover the points in each operation with which you may have had difficulty. In order to increase your skill, take the diagnostic tests given on the pages indicated in the following table and then practise to improve your work.

Process	Whole Numbers		Fractions		Decimals	
	Study Helps	Test	Study Helps	Test	Study Helps	Test
Addition	7	8	22	23	48	49
Subtraction	7	8	25	26	48	49
Multiplication	10	11	29	30	62	63
Division	13, 16	14, 17	34	35	74	75

1. On which pages are the Study Helps for division of whole numbers? Turn to these pages and examine the Study Helps.

2. On which page is the diagnostic test for multiplication of whole numbers? Read the directions for taking the test.

Checking Addition and Subtraction

1. Find the sum in the example on the right. Check the solution by adding in the opposite direction.

2. Another method of checking the addition example in problem 1 consists in writing the sum of each column as shown on the right, then finding the sum of these numbers. Why should the sum of each succeeding column be written in the manner indicated?

```
 723
 456
 938
 857
----
  24
  15
 28
----
2974
```

3. Subtract in the example on the right. Check by adding the remainder to the smaller number. What should the sum of these two numbers equal?

```
 7302
-2857
-----
```

4. By approximation, show that the answer to problem 3 is a little more than 4000. Think, "7302 is about 7000 and 2857 is about 3000." Why must the remainder be more than 4000?

Diagnostic Test in Addition of Whole Numbers

Do not copy the examples on this page. Write the sums on a folded paper placed below each row.

	a	b	c
I.	7	6	4
(354)	9	8	8
	4	5	9
	8	7	5
	5	9	7
	3	2	8

	a	b	c
III.	703	856	490
(354)	958	930	380
	640	786	706
	539	407	439
	216	334	528
	408	928	683

	a	b	c
II.	76	45	94
(354)	39	96	38
	58	87	57
	93	62	64
	46	44	71
	57	58	89

	a	b	c
IV.	461	96	3427
(354)	93	307	675
	748	34	49
	835	1259	7536
	54	682	865
	108	86	36

Check your answers with those given on page 350. If you had more than one example incorrect in any group, turn for practice to the page number given in the parentheses.

Diagnostic Test in Subtraction of Whole Numbers

Write the answers on folded paper placed below each row.

	a	b	c
I.	763	468	826
(355)	138	275	743

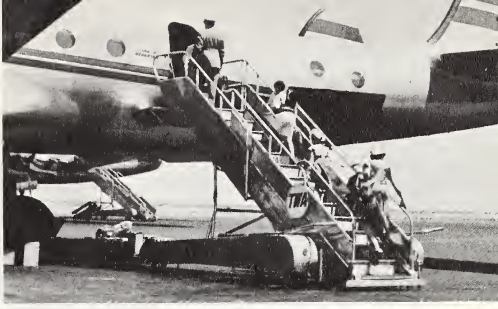
	a	b	c
III.	906	704	3004
(355)	329	508	2508

	a	b	c
II.	431	964	4253
(355)	153	398	1378

	a	b	c
IV.	6124	3012	7003
(355)	807	98	8

Check your answers with those given on page 350. If you had more than one example incorrect in any group, turn for practice to the page number given in the parentheses.

Airline Passengers in One Week



The table gives the number of passengers on board airplanes departing from an airport at the same hours each day of one week.

Day of Week	Passengers on Board Airplane Departing at					
	8 A.M.	11 A.M.	3 P.M.	5 P.M.	7 P.M.	Total
Sunday	27	32	38	44	39	?
Monday	43	36	29	44	41	?
Tuesday	38	33	27	40	39	?
Wednesday	44	35	19	39	42	?
Thursday	36	34	25	24	34	?
Friday	35	29	33	42	40	?
Saturday	44	38	26	34	31	?

It is often necessary to add numbers arranged in rows as shown above. Do not rewrite the numbers. When adding two-place numbers arranged in rows, add first the ones and then the tens.

1. Find the number of airline passengers for each day of the week. Place a sheet of paper along the edge of the above table and write the missing numbers on your paper.

2. Find the total number of airline passengers listed for the week.

3. Find the sum of each column. Then add these sums. Why should this sum be the same as the answer for problem **2**?

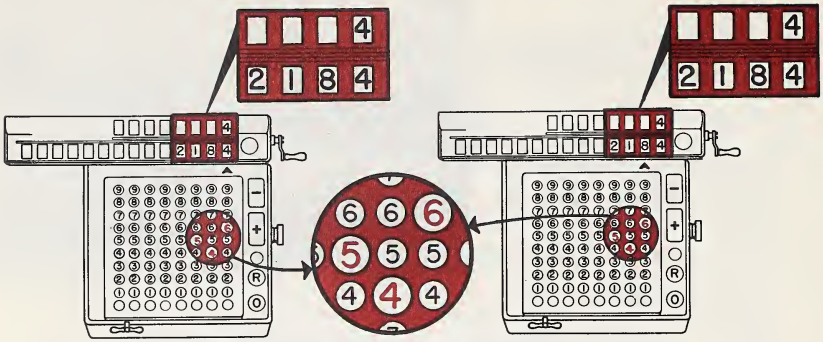
Find the sum in the examples below without recopying.

4. $75 + 38 + 96 + 52 + 19$ **6.** $65 + 80 + 37 + 18 + 54$

5. $14 + 59 + 88 + 36 + 72$ **7.** $91 + 54 + 68 + 73 + 44$

8. $107 + 359 + 468 + 725 + 264 + 146$

★**9.** $635 + 1825 + 94 + 2350 + 946 + 307$



How to Multiply with a Calculating Machine

With this machine it is possible to add, subtract, multiply, and divide. Multiplication is a short cut method to add equal numbers. The machine uses this principle to multiply two numbers.

1. The keys pressed down (circled) represent what number?

2. What number does the 5 represent? the 4? the 6?

The "repeat key" (R) is pressed down first. Then it is possible to add as many 546's as one wishes.

3. To multiply 546 by 4, press the "+ key" 4 times. Why press the "+ key" and not the "− key"?

4. To multiply 546 by 34, how many 546's must be added?

5. To find 34 × 546 more quickly than by adding, we can use the machine first to find 4 × 546, and then 30 × 546. What is the product of 4 × 546? See this partial product recorded in the carriage of the machine. Next we move the carriage which shows the answer so that the next partial product from multiplying by 3 will be one place to the left of ones' place. Multiplying by this 3 is the same as multiplying by 30. Why?

6. The two partial products of the example 34 × 546 are shown on the right. Why is the zero written in ones' place of the second partial product?

```
  2184
 16380
```

7. In the example on the right, 468 is first to be multiplied by 3 and then by what number? What is the product in the example? Why should the second partial product be written two places to the left of ones' place?

```
  468
×203
```

Diagnostic Test in Multiplication of Whole Numbers

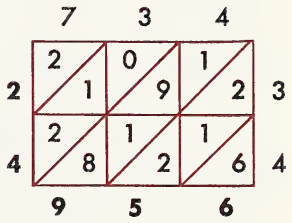
Find the products of the following:

	a	b	c		a	b	c
I.	437	768	5060	**III.**	472	906	450
(356)	×8	×7	×6	(356)	×304	×207	×409
II.	43	524	804	**IV.**	763	970	6104
(356)	×38	×65	×49	(356)	×240	×350	×800

Check your answers with those given on page 350. If you had more than one example incorrect in any group, turn to the page number given in the parentheses for practice.

★Lattice Work in Multiplication

In Europe during the Middle Ages, lattice work, as illustrated on the right, was used for multiplication. In the illustration, 734 is multiplied by 34. By this method, each product is written in full so that it is not necessary to carry while multiplying.



First multiply 734 by 3 and write the products, 12, 9, and 21, as shown in the top row of squares cut by diagonals. Then, multiply 734 by 4 and write the products, as shown in the second row of squares.

The product is found by adding the numbers within the framework diagonally downward to the left, beginning in the lower right corner. The first number is 6 and it is written outside of the lattice work. The next figure in the product is the sum of 2, 1, and 2, or 5. The sum of the next group is 19 (1 + 9 + 1 + 8). Write 9 and carry 1 to the next group. Tell how to find 4 and 2, the other digits in the product. Read the product.

1. Find the product of 34 and 734 by regular multiplication.

2. Use the method shown to find the products of each of the following. Then check each example by regular multiplication.

a. 36 × 84 = b. 76 × 316 = c. 52 × 438 = d. 158 × 907 =

PHOTO BY TUROFSKY-

Hockey Records

The table below gives the standing of the hockey teams in the National Hockey League in January of a recent year.

In the table,
P = Played, W = Won,
L = Lost, T = Tied
F = Goals for, A = Goals against,
Pts. = Points

	P	W	L	T	F	A	Pts.
Detroit	46	26	12	8	123	81	60
Montreal	47	25	17	5	140	102	?
Toronto	44	23	13	8	97	74	?
Boston	46	19	21	6	114	126	?
New York	47	18	23	6	107	133	?
Chicago	48	9	34	5	95	160	?

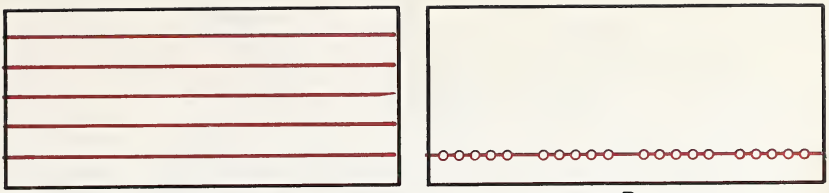
1. If a team counts 2 points for a win and 1 point for a tie, what was the total number of points received by each team? By all teams?

2. What is the total number of goals scored to this date?

3. In a recent year, an All-Star game played in Toronto drew a crowd of 11,469 fans. If the average cost of a ticket was $2.25, what was the gross gate?

★4. The table shows the final results in the Western Hockey League in a recent year. Fill in the blanks.

	P	W	L	T	Pts.
Saskatoon	70			9	79
Vancouver		32	28		74
Calgary		31		12	74
Edmonton	70	21	28		
Seattle	70	30			68
New Westminster		29		8	66
Tacoma	70			12	66
Victoria		26	36		60



The Meaning of Division

A gardener has 100 bulbs to plant in a rectangular garden.

1. He plants 20 bulbs in one row. How many rows are there?

2. He plants the bulbs in 5 equal rows. How many bulbs does he plant in each row?

3. Problems **1** and **2** are both solved by division. Which illustration shows the answer to problem 1? Which shows the answer to problem **2**?

4. Division shows:

(a) How many times one number can be taken out of another number. (In this case division is a short way to subtract.)

(b) The size of the equal parts into which a number is divided. Which problem shows the first usage? the second usage?

5. Dividing a number into 5 equal parts is the same as finding what fractional part of the number?

6. Divide 411 by 7.

```
  58 r5
7)411
  35
  61
  56
   5
```

a. Trace the steps in the solution.

b. To check the answer, multiply the quotient (58) by the divisor (7) and then add the remainder to the product. The sum should equal the dividend (411). Check the solution.

c. See if you can divide without writing out all of the work.

7. Divide 3763 by 8.

```
  470 r3
8)3763
  32
```

a. Why is the 4 written in hundreds' place?

b. If the zero is not written in the quotient, what value does the 4 then have?

c. Prove that the quotient is correct.

Diagnostic Test for One-Place Divisors and for Easy Two-Place Divisors

MORE PRACTICE 372

Solve each of the following examples and check the work.

	a	b	c		a	b	c
I. (357)	$6\overline{)4752}$	$4\overline{)9573}$	$9\overline{)5879}$	III. (357)	$8\overline{)5110}$	$9\overline{)6200}$	$7\overline{)6123}$
II. (357)	$4\overline{)9628}$	$6\overline{)8820}$	$7\overline{)6862}$	IV. (357)	$30\overline{)8250}$	$50\overline{)9163}$	$80\overline{)3725}$

Check your answers with those given on page 350. If you had more than one example incorrect in any group, turn for practice to the page number given in the parentheses.

Number Quickies

1. The length of a car from bumper to bumper is 204 inches. What is the length of the car in feet?

2. If 4 grapefruit cost 25¢, how many can be bought for a dollar?

3. A mill is $\frac{1}{10}$ of a cent. How many mills are there in a dollar?

4. What is the area of a square 6 inches on a side?

5. What is the perimeter of a square 8 feet on a side?

6. What number multiplied by 9 gives a product of 4509?

7. How many pints are there in $3\frac{1}{2}$ gallons?

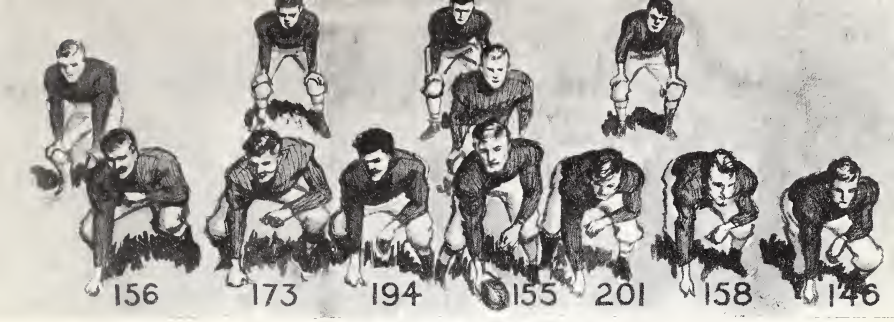
8. A car travels 7 miles in 10 minutes. At that speed, how many miles will it travel in one hour?

9. At a speed of 45 m.p.h. (miles per hour), how long does it take a car to travel 30 miles?

10. If 1 in. on a bar graph represents $1000, what amount does a bar $2\frac{3}{4}$ in. long represent?

11. Alice paid $1.20 for $\frac{3}{4}$ pound of salted nuts. At that rate, what is the cost of a pound of salted nuts?

12. How many minutes are there in a day?



Finding an Average

The picture shows the Park High School football team. The players kneeling play "on the line" and those standing play "in the backfield." The number below each lineman represents his weight in pounds.

1. What is the total weight of the seven players who play "on the line"?

2. The **average** of two or more numbers is equal to their sum divided by the number of numbers. What is the average weight of the players "on the line"?

3. The weights of the players in the backfield are 158 lb., 161 lb., 146 lb., 139 lb., and 175 lb. What is the average weight of the players in the backfield?

4. What is the average weight of all the players on the team?

5. To answer problem 4, Dick added the average weight of the players on the line to the average weight of the players in the backfield and divided the sum by 2. What was his answer? Why does this figure not give the correct average weight of the boys on the team?

6. At a store the sales for each day of a week were as follows:

Monday, $158	Wednesday, $436	Friday, $307
Tuesday, $219	Thursday, $279	Saturday, $614

What were the average daily sales for the week?

★7. The average weight of the players on a basketball team is 153 pounds. If the weights of four of the players are 143 lb., 137 lb., 164 lb., and 149 lb., what is the weight of the fifth player?

Important Points about Two-or-More-Place Divisors

The following are important points to observe when the divisor is a two-or-more-place number:

A. The **guide figure** for estimation of the quotient is the first figure on the left of the divisor, as 3 in 348.

B. The estimated quotient figure is the true quotient figure when the product of this figure and the divisor is equal to or less than each **partial dividend.** See example **1.**

C. When the estimated quotient figure is too large, make it one less until the true quotient figure is found. See example **2.**

1. Divide 3264 by 34.

```
  96
34)3264
  306
  ---
  204
  204
  ---
```

a. Why is the 9 written in tens' place?

b. There **seem** to be more than 9 threes in 32, but try 9. Is 9 correct?

2. Divide 1976 by 27.

```
   7
27)1976
  189
  ---
   86
```

a. How many 2's are there in 19? What is the true quotient figure?

b. Find the next quotient figure.

c. Check your answer.

3. Divide 7654 by 435.

```
  17
435)7654
  435
  ----
  3304
```

a. We estimate the first quotient figure as $4\overline{)7}$. Why is the 1 written in tens' place?

b. Show how to estimate the second quotient figure. Complete the solution.

4. Complete each of the following solutions. Check your work.

a. $56\overline{)9856}$ → 176

b. $36\overline{)2520}$ → 7?

c. $38\overline{)7410}$ → 19?

d. $16\overline{)9123}$ → 5?? r3

e. $365\overline{)8456}$ → 2? r?

f. $185\overline{)6747}$ → ?6 r87

MORE PRACTICE

Diagnostic Test With Two-or-More-Place Divisors

Divide the following:

	a	b	c		a	b	c
I. (358)	$43\overline{)1568}$	$58\overline{)5362}$	$76\overline{)6245}$	**III.** (358)	$36\overline{)9253}$	$24\overline{)8255}$	$67\overline{)3248}$
II. (358)	$32\overline{)9824}$	$45\overline{)3600}$	$54\overline{)9185}$	**IV.** (358)	$27\overline{)1639}$	$38\overline{)3124}$	$17\overline{)9142}$

	a	b	c
V. (359)	$315\overline{)9746}$	$432\overline{)7496}$	$528\overline{)38597}$
VI. (359)	$261\overline{)96573}$	$180\overline{)84613}$	$365\overline{)184276}$

Check your answers with those given on page 350. If you had more than one example incorrect in any group, turn for practice to the page number given in the parentheses.

★Checking Division by Casting Out 9's

Casting out 9's is a check for division. If a number is not divisible by 9, as 13, the sum of the digits of this number is the remainder when divided by 9. Thus, $13 \div 9 = 1$ r4. The sum of the digits in 13 is $1 + 3$, or 4. When the sum of the digits is a two-place number, as in 736 ($7 + 3 + 6 = 16$), find the sum of the digits in 16, or $1 + 6 = 7$. When 736 is divided by 9, the remainder is 7. The remainder is called **the excess of 9's**

$$35\overline{)1347} \quad 38 \text{ r}17$$

In the example on the right, if the final remainder (17) is subtracted from 1347, the answer (1330) is equal to the product of divisor and quotient, or $35 \times 38 = 1330$.

If the product of the excesses of 9's in 35 and in 38 is equal to the excess of 9's in 1330, the division checks by casting out 9's. Show that the product of the excesses of 9's in 35 and 38 becomes 7. Show that the excesses of 9's in 1330 is equal to 7. Check the examples in **V** and **VI** above by casting out 9's.

Rounding Off the Quotient

1. Mr. Brown drove his car 1275 miles. If the car used 82 gallons of gasoline, what was the average number of miles travelled per gallon of gasoline used? Express the result to the nearest mile.

```
  15
82)1275
   82
  455
  410
   45
```

What is the final remainder?
Is it more or less than half the divisor (82)?
Think, "$\frac{1}{2}$ of 82 = 41, so 45 is more than $\frac{1}{2}$ of 82."

To the nearest mile, the car averaged 16 miles per gallon.

To round off the quotient to the nearest whole number, when there is a final remainder, proceed as follows:

If the final remainder is less than half the divisor, drop the remainder; if the final remainder is equal to or greater than half the divisor, increase the last quotient figure by 1.

2. The table below shows the sales made in a grocery store for each day in the week for 4 weeks of a month. To the nearest dollar, find the average sale for each day of the week; for each week.

Day	First Week (1)	Second Week (2)	Third Week (3)	Fourth Week (4)	Average for Each Day
a. Monday	$ 346	$ 287	$ 352	$ 269	?
b. Tuesday	429	398	516	454	?
c. Wednesday	645	746	728	638	?
d. Thursday	897	938	935	1052	?
e. Friday	1236	1317	1429	1523	?
f. Saturday	1064	1029	1158	1096	?
Average for each week	?	?	?	?	

3. What were the total sales for the four-week period?

MORE PRACTICE

The Cost of Careless Driving

ONT. DEPT. OF HIGHWAYS

The table below shows the number of deaths in a recent year due to Motor Vehicle accidents in each Province of Canada per 10,000 registered motor vehicles. Most of these deaths could have been prevented by safe-driving. All provinces have a Safety division which is trying to educate young drivers in the ways of safety.

Deaths per 10,000 Registered Motor Vehicles

Newfoundland	P.E.I.	N.S.	N.B.	Que.	Ont.	Man.	Sask.	Alta.	B.C.	Total
10.99	4.55	9.92	13.84	15.73	7.70	4.76	4.55	7.02	6.95	8.73

1. Which two provinces had the lowest death rate per 10,000 motor vehicles registered?

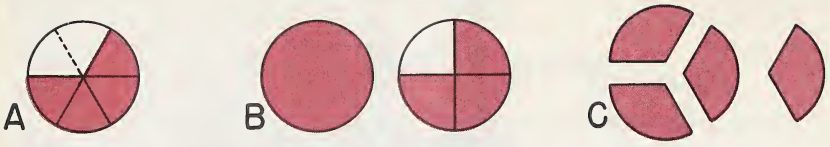
2. Which province had the highest death rate per 10,000 motor vehicles registered?

★3. Newfoundland had 16,500 registered motor vehicles in the year of the table above. How many deaths due to motor vehicles occurred?

★4. Saskatchewan had 200,000 registered motor vehicles in the same year. How many deaths due to motor vehicles occurred?

★5. In the whole of Canada in the same year there were 2,600,000 registered motor vehicles. How many deaths due to motor vehicles occurred?

★6. What steps has your community taken to prevent motor vehicle accidents?



The Language of Common Fractions

1. What part of the whole does each part in A represent? How many sixths are shaded?

2. A fraction has two **terms.** The **numerator** is the upper term and the **denominator** is the lower term. In the fraction $\frac{4}{6}$, what is the numerator? the denominator? What does the fraction $\frac{4}{6}$ mean? What are the terms of the fraction $\frac{4}{6}$?

3. Use diagram A to show that $\frac{4}{6} = \frac{2}{3}$. The fraction $\frac{4}{6}$ is **reduced to lowest terms** when it is expressed as $\frac{2}{3}$. When a fraction is reduced to lowest terms, the parts are larger, but fewer in number. Illustrate.

4. What does the whole disk in B represent? What part of a whole is each fractional part in B? What fraction is represented in B?

5. What is the value of each fractional part in C? How many of these parts does it take to make 1 whole? Make a drawing to show that the sum of the parts in C is equal to $1\frac{1}{3}$.

6. A **proper fraction** has a value less than 1 whole. Which illustration represents a proper fraction?

7. An **improper fraction** is equal to or greater than 1 whole. Which illustration represents an improper fraction?

8. A **mixed number** consists of a whole number and a fraction. Which illustration represents a mixed number?

9. State which of the following are proper fractions; which are improper fractions; which are mixed numbers:

a. $\frac{7}{8}$ b. $\frac{9}{6}$ c. $1\frac{4}{6}$ d. $\frac{4}{4}$ e. $\frac{3}{2}$ f. $\frac{5}{4}$ g. $2\frac{1}{4}$ h. $\frac{6}{9}$

10. In problem 9, which of the numbers are not expressed in simplest form?

11. Write an improper fraction greater than 1 whole. What is the smallest numerator it can have if its denominator is 3? 6? 8? 12?

Changing Fractions to Equivalents

Two fractions are **equivalent** if they have the same value. The fractions $\frac{2}{3}$ and $\frac{4}{6}$ are equivalent, because they have the same value.

1. Reduce the fraction $\frac{12}{16}$ to lowest terms.

A

$$\frac{12}{16} = \frac{12 \div 2}{16 \div 2} = \frac{6}{8}; \quad \frac{6 \div 2}{8 \div 2} = \frac{3}{4}$$

B

$$\frac{12}{16} = \frac{12 \div 4}{16 \div 4} = \frac{3}{4}$$

Use the two illustrations to show that the work is shortened if both terms of a fraction are divided by the largest number possible.

2. Reduce each of the following to lowest terms:

a. $\frac{9}{12}$	c. $\frac{9}{15}$	e. $\frac{4}{10}$	g. $\frac{16}{32}$	i. $\frac{8}{24}$	k. $\frac{24}{32}$
b. $\frac{16}{24}$	d. $\frac{8}{12}$	f. $\frac{12}{20}$	h. $\frac{10}{18}$	j. $\frac{9}{24}$	l. $\frac{16}{20}$

3. Change the fraction $\frac{8}{3}$ to a mixed number.

A

$$\frac{8}{3} = \frac{3}{3} + \frac{3}{3} + \frac{2}{3} = 1 + 1 + \frac{2}{3} = 2\frac{2}{3}$$

B

$$\frac{8}{3} = 3\overline{)8}\ 2\frac{2}{3}$$

To change an improper fraction to a mixed number, divide the numerator by the denominator.

4. Change the following to mixed numbers in lowest terms:

a. $\frac{5}{2}$	c. $\frac{14}{6}$	e. $\frac{25}{8}$	g. $\frac{14}{3}$	i. $\frac{21}{6}$	k. $\frac{24}{12}$
b. $\frac{10}{4}$	d. $\frac{18}{4}$	f. $\frac{22}{8}$	h. $\frac{18}{8}$	j. $\frac{24}{15}$	l. $\frac{22}{10}$

5. Change $\frac{5}{8}$ to 24ths.

$\frac{5}{8} = \frac{?}{24}$; $\frac{3 \times 5}{3 \times 8} = \frac{15}{24}$ Why do we multiply by 3?

The number of 24ths in $\frac{1}{8}$ is found by dividing 24 by 8. Both numerator and denominator of the fraction $\frac{5}{8}$ are then multiplied by 3.

6. Find the missing numbers in each of the following:

a. $\frac{3}{8} = \frac{?}{16}$	c. $\frac{2}{3} = \frac{?}{12}$	e. $\frac{2}{5} = \frac{?}{20}$	g. $\frac{5}{8} = \frac{15}{?}$
b. $\frac{5}{6} = \frac{?}{24}$	d. $\frac{4}{7} = \frac{?}{28}$	f. $\frac{3}{4} = \frac{?}{32}$	h. $\frac{6}{7} = \frac{18}{?}$

Important Points in Addition of Fractions

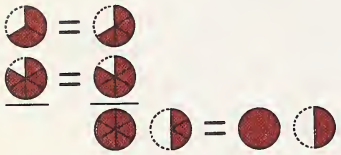
A. Fractions cannot be added unless they have like denominators. See the illustrations below.

B. The sum of two or more fractions having like denominators is the sum of the numerators divided by the common denominator. Fractions can always be changed to have like denominators.

C. Fractions in the sum should be expressed in simplest form.

D. To add mixed numbers, first add the fractions, then add the whole numbers, and then add the two sums. See examples **2** and **3.**

1. Add $\frac{2}{3}$ and $\frac{5}{6}$.



$\frac{2}{3} = \frac{4}{6}$

$+\frac{5}{6} = \frac{5}{6}$

$\frac{9}{6} = 1\frac{3}{6} = 1\frac{1}{2}$

Use the diagram to explain the steps in the solution.

2. Add $3\frac{1}{4}$ and $5\frac{2}{3}$.

$3\frac{1}{4} = 3\frac{3}{12}$

$+5\frac{2}{3} = 5\frac{8}{12}$

a. What is the product of the two denominators? What is the common denominator?

b. Complete the solution.

3. Add $5\frac{3}{4}$ and $3\frac{5}{6}$.

$5\frac{3}{4} = 5\frac{9}{12}$

$+3\frac{5}{6} = 3\frac{10}{12}$

$8\frac{19}{12} = 8 + 1\frac{7}{12} =$

a. What is the product of the two denominators?

b. What is the smallest possible common denominator?

c. Complete the solution.

4. Add $\frac{5}{6}$, $\frac{7}{8}$ and $\frac{3}{4}$.

$\frac{5}{6} = \frac{20}{24}$

$\frac{7}{8} = \frac{21}{24}$

$\frac{3}{4} = \frac{18}{24}$

a. What is the largest denominator? Multiply it by 2. Is this product a common denominator?

b. Multiply the largest denominator by 3. Is this product a common denominator?

c. Complete the solution.

If none of the denominators of three or more unlike fractions is a common denominator, multiply the largest denominator by 2; by 3; by 4; and so on to find a common denominator.

MORE PRACTICE

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Diagnostic Test in Addition of Fractions

Find the sums of the following:

	a	b	c	d	e	
I.	$\frac{1}{5}$	$\frac{4}{9}$	$\frac{7}{10}$	$9\frac{1}{3}$	$2\frac{4}{5}$	(360)
	$\frac{3}{5}$	$\frac{7}{9}$	$\frac{4}{10}$	$6\frac{1}{3}$	$1\frac{3}{5}$	
II.	$\frac{3}{8}$	$\frac{5}{12}$	$\frac{7}{9}$	$6\frac{5}{6}$	$7\frac{3}{8}$	(360)
	$\frac{7}{8}$	$\frac{11}{12}$	$\frac{2}{9}$	$4\frac{5}{6}$	$\frac{5}{8}$	
III.	$\frac{7}{12}$	$\frac{1}{2}$	$\frac{5}{6}$	$8\frac{1}{2}$	$\frac{9}{10}$	(360)
	$\frac{1}{3}$	$\frac{3}{4}$	$\frac{1}{3}$	$2\frac{3}{4}$	$3\frac{1}{5}$	
IV.	$\frac{3}{10}$	$\frac{3}{4}$	$\frac{5}{6}$	$7\frac{1}{4}$	$\frac{5}{6}$	(360)
	$\frac{1}{2}$	$\frac{7}{12}$	$\frac{2}{3}$	$8\frac{5}{12}$	$4\frac{1}{2}$	
V.	$\frac{2}{3}$	$\frac{3}{4}$	$\frac{1}{4}$	$9\frac{1}{4}$	$\frac{5}{6}$	(360)
	$\frac{1}{2}$	$\frac{1}{3}$	$\frac{5}{6}$	$2\frac{1}{3}$	$8\frac{7}{8}$	
VI.	$\frac{7}{8}$	$\frac{1}{4}$	$\frac{7}{9}$	$8\frac{3}{4}$	$\frac{7}{8}$	(360)
	$\frac{2}{3}$	$\frac{5}{6}$	$\frac{2}{3}$	$2\frac{1}{3}$	$\frac{3}{4}$	
	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{1}{6}$	$4\frac{1}{6}$	$4\frac{5}{6}$	

Check your answers with those given on page 351. If you had more than one example incorrect in any group, review the Study Helps on page 22. For practice, turn to the page number given in the parentheses.

★Forming a Magic Square with Fractions

If the vacant **cells** in the square on the right are filled with the correct fractions, the sums of the fractions in each row or column or diagonal are the same. This will then be a true magic square.

$\frac{2}{3}$	?	$\frac{1}{2}$
$\frac{1}{4}$	?	?
$\frac{1}{3}$	$\frac{3}{4}$	?

Which column enables you to find the sum of the magic square? Find the missing numbers.

Charles Phelps Cushing

The Water Supply of a City

1. A city reservoir contains 3 billion gallons of water. If the daily consumption is 20 million gallons, how long will this supply of water meet the needs of the city?

Every division example may be represented as a fraction.

$$\frac{3{,}000{,}000{,}000}{20{,}000{,}000} = \frac{3{,}00\text{Ø}{,}\text{ØØØ}{,}\text{ØØØ}}{2\text{Ø}{,}\text{ØØØ}{,}\text{ØØØ}} = \frac{300}{2} = 150$$

Divide both numerator and denominator by 10,000,000.

The number in the numerator contains 9 zeros and in the denominator, 7 zeros. Then, both terms of the fraction on the left may be divided by a number containing 7 zeros, or 10,000,000. Dividing by 10,000,000 is the same as crossing off 7 zeros in each term of the fraction, as shown. The supply is enough for 150 days.

2. Find the number of days the water supply in each reservoir in the table would last at the daily consumption rates given.

	Capacity in Gallons	Consumption in Gallons
a.	28 billion	100 million
b.	50 billion	250 million
c.	6 billion	25 million

	Capacity in Gallons	Consumption in Gallons
d.	600 million	4 million
e.	750 million	5 million
f.	275 billion	2 billion

3. Divide each of the following:

a. 750,000 by 25,000

b. 1 billion by 5 million

c. 175,000 by 2500

d. 100 million by 25,000

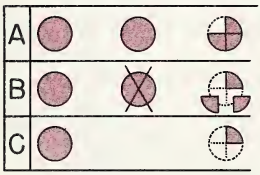
Important Points in Subtraction of Fractions

A. Fractions must have like denominators before they can be subtracted. When they do not have like denominators, they must be changed so that they do. See examples 1 and 3.

B. To subtract a mixed number from a whole number, regroup the whole number so that there is an improper fraction. Take 1 from the whole number, change the 1 to a fraction having the denominator of the fraction to be subtracted, and add this improper fraction to the remaining whole number. See example 2.

C. When the fraction of the upper mixed number is smaller than the fraction in the number to be subtracted, regroup the whole number of the upper number as was done in **B**. Then add the fraction of the top number to the one whole changed to a fraction, thus making an improper fraction. See example 3.

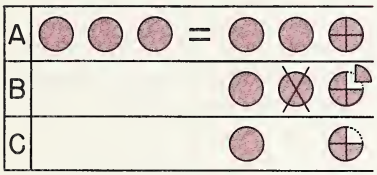
1. Subtract $1\frac{1}{2}$ from $2\frac{3}{4}$.



$2\frac{3}{4} = 2\frac{3}{4}$
$1\frac{1}{2} = 1\frac{2}{4}$
$1\frac{1}{4}$

Use the diagram to explain the steps in the solution. Check the answer.

2. Subtract $1\frac{1}{4}$ from 3.



$3 = 2\frac{4}{4}$
$1\frac{1}{4} = 1\frac{1}{4}$
$1\frac{3}{4}$

Use the diagram to explain the steps in the solution. Check the answer.

3. Subtract $1\frac{5}{6}$ from $2\frac{1}{3}$.

$2\frac{1}{3} = 2\frac{2}{6} = 1\frac{8}{6}$
$1\frac{5}{6} = 1\frac{5}{6} = 1\frac{5}{6}$
$\frac{3}{6} = \frac{1}{2}$

a. How was $2\frac{2}{6}$ regrouped to make $1\frac{8}{6}$?
b. Check the answer.

MORE PRACTICE

Diagnostic Test in Subtraction of Fractions

Copy the following examples and subtract. Reduce fractions in the answers to lowest terms.

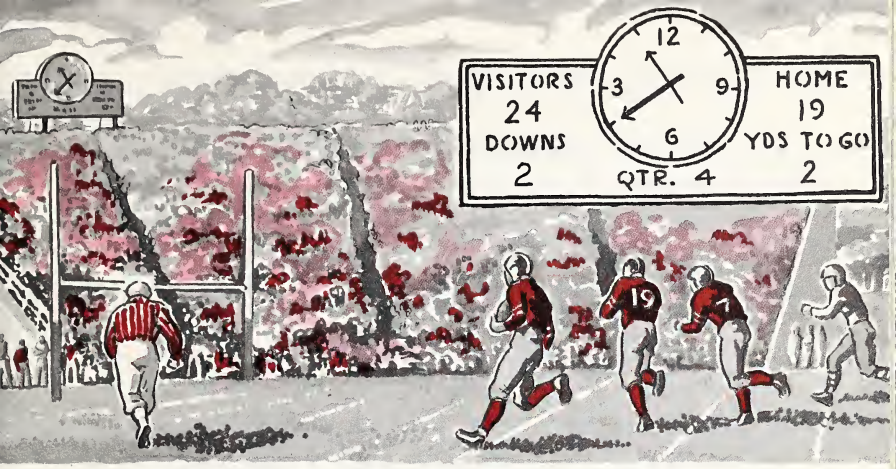
	a	b	c	d	e	
I.	$\frac{7}{8}$ $\frac{4}{8}$	$\frac{11}{12}$ $\frac{5}{12}$	$9\frac{3}{4}$ $6\frac{1}{4}$	$4\frac{5}{6}$ $4\frac{1}{6}$	$8\frac{3}{5}$ $6\frac{3}{5}$	(361)
II.	$\frac{7}{8}$ $\frac{3}{4}$	$\frac{9}{10}$ $\frac{1}{2}$	$7\frac{1}{2}$ $4\frac{1}{6}$	$5\frac{3}{5}$ $\frac{3}{10}$	$11\frac{2}{3}$ $11\frac{1}{6}$	(361)
III.	$\frac{3}{4}$ $\frac{2}{3}$	$\frac{7}{8}$ $\frac{2}{3}$	$9\frac{3}{4}$ $4\frac{1}{6}$	$6\frac{2}{3}$ $\frac{1}{4}$	$7\frac{1}{2}$ $1\frac{2}{5}$	(361)
IV.	6 $2\frac{1}{3}$	1 $\frac{4}{5}$	3 $2\frac{5}{6}$	9 $7\frac{3}{4}$	10 $5\frac{7}{8}$	(362)
V.	$1\frac{1}{5}$ $\frac{4}{5}$	$8\frac{1}{6}$ $7\frac{5}{6}$	$7\frac{1}{3}$ $6\frac{2}{3}$	$10\frac{3}{8}$ $\frac{7}{8}$	$9\frac{1}{4}$ $2\frac{3}{4}$	(362)
VI.	$7\frac{2}{3}$ $4\frac{5}{6}$	$6\frac{1}{2}$ $5\frac{7}{8}$	$9\frac{1}{4}$ $\frac{7}{12}$	$1\frac{1}{6}$ $\frac{2}{3}$	$12\frac{1}{8}$ $5\frac{1}{2}$	(362)
VII.	$4\frac{2}{3}$ $1\frac{3}{4}$	$7\frac{1}{2}$ $4\frac{3}{5}$	$9\frac{1}{4}$ $8\frac{5}{6}$	$7\frac{1}{2}$ $4\frac{2}{3}$	$10\frac{2}{3}$ $\frac{7}{8}$	(362)

Check your answers with those given on page 351. If you had more then one example incorrect in any group, review the Study Helps on page 25. For practice, turn to the page number given in the parentheses.

★For Those Who Made No Errors on the Above Test

Study the drawings in examples 1 and 2 on page 25. Then make drawings like them or use cut-outs to show the steps in working the following examples:

1. $2 - \frac{2}{3}$ 2. $3\frac{1}{2} - 1\frac{1}{4}$ 3. $2\frac{1}{2} - 1\frac{3}{4}$



Changing Units of Measure

1. How much time remains to be played in the football game? Express the time as minutes and seconds; express the time as seconds.

We **multiply** to change from a large unit of measure to a smaller unit of measure. There will be more but smaller units.

Change 3 feet to inches. $3 \times 12 = 36$, the number of inches.

We **divide** to change from a small unit of measure to a larger unit of measure. There will be fewer but larger units.

Change 32 ounces to pounds. $32 \div 16 = 2$, the number of pounds.

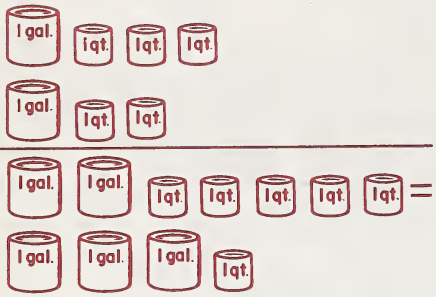
Find the missing numbers below. (Use the tables on page 349 if needed.)

	a	b	c
2.	6 lb. = ? oz.	27 oz. = ? lb.	3 tons = ? lb.
3.	8 ft. = ? in.	4 yd. = ? in.	42 in. = ? ft.
4.	5 gal. = ? qt.	18 pt. = ? gal.	15 pt. = ? qt.
5.	3 bu. = ? pk.	8 min. = ? sec.	3 hr. = ? min.
6.	4 da. = ? hr.	2 pk. = ? qt.	40 fl.oz. = ? pt.
7.	3 yd. = ? in.	28 in. = ? ft.	36 pt. = ? gal.
8.	15 pt. = ? qt.	90 sec. = ? min.	72 hr. = ? da.

MORE PRACTICE

We May Add and Subtract Measurements

1. Find the sum of 1 gal. 3 qt. and 1 gal. 2 qt.



$$\begin{array}{r} 1 \text{ gal. } 3 \text{ qt.} \\ +1 \text{ gal. } 2 \text{ qt.} \\ \hline 2 \text{ gal. } 5 \text{ qt.} = \\ 2 \text{ gal. } + 1 \text{ gal. } 1 \text{ qt.} = \\ 3 \text{ gal. } 1 \text{ qt.} \end{array}$$

Use the diagram to trace the steps in the solution on the right.

2. Check the solution in problem 1 by use of common fractions.

$$1 \text{ gal. } 3 \text{ qt.} = 1\tfrac{3}{4} \text{ gal.; } 1 \text{ gal. } 2 \text{ qt.} = 1\tfrac{1}{2} \text{ gal.}$$
$$1\tfrac{3}{4} \text{ gal. } + 1\tfrac{1}{2} \text{ gal. } = ?$$

3. Subtract the following:

a. 2 gal. 3 qt. from 4 gal.

$$\begin{array}{rl} 4 \text{ gal.} & = 3 \text{ gal. } 4 \text{ qt.} \\ \underline{2 \text{ gal. } 3 \text{ qt.}} & = \underline{2 \text{ gal. } 3 \text{ qt.}} \\ & 1 \text{ gal. } 1 \text{ qt.} \end{array}$$

b. 3 ft. 9 in. from 8 ft. 5 in.

$$\begin{array}{rl} 8 \text{ ft. } 5 \text{ in.} & = 7 \text{ ft. } 17 \text{ in.} \\ \underline{3 \text{ ft. } 9 \text{ in.}} & = \underline{3 \text{ ft. } 9 \text{ in.}} \\ & 4 \text{ ft. } 8 \text{ in.} \end{array}$$

4. Add the following and check by use of common fractions:

a. 5 ft. 9 in.
1 ft. 5 in.

b. 5 yd. 24 in.
2 yd. 30 in.

c. 5 hr. 20 min.
2 hr. 45 min.

d. 9 lb.
5 lb. 8 oz.

e. 6 bu. 2 pk.
5 bu. 3 pk.

f. 4 pt.
1 pt. 10 fl.oz.

MORE PRACTICE

5. Subtract the examples in problem 4 and check by use of common fractions.

★6. Find the sum of: 19 min. 30 sec., 12 min. 40 sec., and 1 min. 15 sec. Express the answer as minutes; as seconds.

Important Points in Multiplication of Fractions

A. To multiply a fraction by a whole number or to find a fractional part of a whole number, multiply the numerator of the fraction by the number. Divide this product by the denominator.

1. Find $3 \times \frac{3}{4}$.

$3 \times \frac{3}{4} = \frac{3 \times 3}{4} = \frac{9}{4} = ?$ Complete the solution. Check by addition.

2. Find $\frac{5}{6}$ of 8.

$\frac{5}{6}$ of $8 = \frac{5}{6} \times 8 = \frac{5 \times 8}{6} = ?$ Complete the solution.

B. To multiply two fractions, multiply the two numerators. Divide this product by the product of the denominators.

3. Multiply $\frac{3}{4} \times \frac{7}{8}$.

$\frac{3}{4} \times \frac{7}{8} = \frac{3 \times 7}{4 \times 8} = ?$ Complete the solution.

C. Sometimes, before we multiply, we may divide the numerator of one fraction and the denominator of another fraction by a number greater than 1 to make the work easier. This use of division is known as **cancellation**

4. Use cancellation in finding the product of $\frac{3}{8}$ and $\frac{5}{6}$.

$\frac{\cancel{3}^{1}}{8} \times \frac{5}{\cancel{6}_{2}} = \frac{1 \times 5}{8 \times 2} = ?$

By what number were a numerator of one fraction and a denominator of the other fraction divided?

Complete the solution.

D. To multiply mixed numbers, change the mixed numbers to improper fractions and then multiply.

5. Find the product of $1\frac{1}{2} \times \frac{3}{4} \times 2\frac{1}{3}$.

$1\frac{1}{2} \times \frac{3}{4} \times 2\frac{1}{3} = \frac{3}{2} \times \frac{\overset{1}{\cancel{3}}}{4} \times \frac{7}{\cancel{3}_{1}} = \frac{3 \times 1 \times 7}{2 \times 4 \times 1} = ?$ Complete the solution.

6. Multiply $46 \times 5\frac{3}{4}$.

$$\begin{array}{r} 46 \\ \times 5\frac{3}{4} \\ \hline 34\frac{1}{2} \quad (\frac{3}{4} \times 46) \\ +230 \quad (5 \times 46) \end{array}$$

a. Trace the steps in the solution.

b. Complete the solution.

c. Give a rule for multiplying a whole number by a mixed number.

MORE PRACTICE

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Diagnostic Test in Multiplication of Fractions

Multiply. Reduce the fractions in the answers to lowest terms.

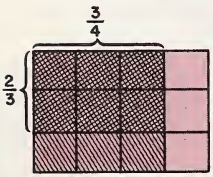
	a	b	c	d	
I.	$12 \times \frac{3}{4} =$	$6 \times \frac{1}{8} =$	$4 \times \frac{3}{5} =$	$\frac{5}{6} \times 15 =$	(363)
II.	$\frac{5}{8} \times 16 =$	$\frac{2}{3} \times 20 =$	$\frac{3}{8} \times 2 =$	$\frac{7}{8} \times 60 =$	(363)
III.	$\frac{1}{2} \times \frac{5}{8} =$	$\frac{3}{4} \times \frac{5}{9} =$	$\frac{9}{10} \times \frac{5}{6} =$	$\frac{4}{9} \times \frac{11}{12} =$	(363)
IV.	$1\frac{1}{2} \times \frac{3}{4} =$	$\frac{4}{5} \times 3\frac{1}{3} =$	$2\frac{1}{4} \times 3\frac{1}{2} =$	$\frac{5}{8} \times 1\frac{1}{3} =$	(363)
V.	$26 \times 2\frac{3}{4}$.	$56 \times 4\frac{2}{3}$	$27\frac{1}{2} \times 5$	$87\frac{3}{4} \times 6$	(363)

VI. a. $2\frac{1}{2} \times 3\frac{1}{4} \times \frac{5}{8} =$ b. $9 \times 6\frac{1}{2} \times 4\frac{2}{3} =$ c. $3\frac{1}{7} \times 1\frac{1}{2} \times 2\frac{4}{5} =$ (363)

Check your answers with those given on page 351. If you had more than one example incorrect in any group, review the Study Helps on page 29. For practice, turn to the page number given in the parentheses.

★For Those Who Made No Errors on the Above Test

1. If $\frac{3}{4}$ of a garden is planted with vegetables and $\frac{2}{3}$ of the vegetable garden is planted with potatoes, the part planted with potatoes is what part of the whole garden? Use the diagram on the left to find the answer. Make a copy of the diagram and shade the part to represent the answer.



2. Why is the product of two proper fractions always less than either of the two fractions that are being multiplied?

3. If the product of two fractions is 1, each fraction is called the **reciprocal** of the other fraction, as in the example $\frac{2}{3} \times \frac{3}{2} = 1$. Thus, $\frac{2}{3}$ is the reciprocal of $\frac{3}{2}$, or $1\frac{1}{2}$. Likewise, 2 is the reciprocal of $\frac{1}{2}$, since 2, or $\frac{2}{1} \times \frac{1}{2} = 1$. Write the reciprocal of each of the following: $\frac{3}{4}$; 6; $1\frac{2}{3}$; 7; $2\frac{1}{4}$; $\frac{7}{8}$.

★4. Look up the meaning of reciprocal in your dictionary.

The Vocabulary of Mathematics

Define, illustrate, or use in a sentence each of the terms given below. The number in parentheses shows where the term is first used.

Abacus	(1)	Mixed number	(20)
Approximate amount	(4)	Numerator	(20)
Average of numbers	(15)	Partial dividend	(16)
Cancellation	(29)	Partial product	(10)
Denominator	(20)	Place value	(2)
Dividend	(13)	Proper fraction	(20)
Divisor	(13)	Quotient	(13)
Equivalent	(21)	Reduction of fractions	(21)
Guide figure	(16)	Round numbers	(4)
Improper fraction	(20)	Terms of a fraction	(20)

Number Quickies

1. How many hours are there from 8 A.M. to 3 P.M.?

2. The owner of a car purchased 1000 gal. of gasoline in a recent year. If the tax was 11¢ a gallon, how much was the total tax that he paid on the gasoline?

3. Potatoes sell at $2.14 for a 100-pound bag or $1.50 a bushel (60 lb.). How much cheaper is it to buy 100 lb. of potatoes by the bag than by the bushel?

4. Use Roman numerals to write the number 1964.

5. If an automobile tire costs $15 and can be expected to give 1000 miles' service for each 60¢ of the cost, what total mileage can the tire be expected to give?

6. If 8 barrels of oil are needed to sprinkle $\frac{1}{2}$ mi. of road, how many barrels of oil are needed to sprinkle $10\frac{1}{2}$ mi. of road?

7. A candle $1\frac{1}{2}$ in. long will burn an hour. At that rate, how many hours will a candle 9 in. long burn?

8. What is the smallest four-place whole number that can be divided by 3 without a remainder?

Electing by Majority Vote

The students of the Tupper Junior High School have a Student Organization. Each year the students elect a president of the organization. To be elected president, a candidate must receive a **majority** vote. To have a majority of votes, it is necessary to have at least one more than half the total number of votes cast.

1. If there were 359 votes cast for president of the Student Organization, the winning candidate had to receive at least how many votes?

2. At least how many votes are necessary for a majority when the number of votes cast is 76? 128? 1250? 3647?

3. There are 265 members in the Canadian House of Commons. How many votes are needed for a majority?

4. Canada's Senate has 102 members. At least how many are needed for a majority of the Senate?

5. The table below shows the number of members who represent each of the ten Canadian provinces and Yukon in the House of Commons.

Ontario	85	Alberta	17	Newfoundland	7
Quebec	75	Manitoba	14	Prince Edward Island	4
Saskatchewan	17	Nova Scotia	12	Yukon	1
British Columbia	22	New Brunswick	10	N. W. Territories	1

Which two provinces together would constitute a majority of members in the House?

★6. In some cities in Canada, the single transferable vote method is used. Can you find out how this system works?

Representation in the House of Commons Before and After a Recent Election

Province	Representation Before Election	Representation After Election	Population as per 1951 Census
Alberta	17	17	940,000
British Columbia	18	22	1,165,000
Manitoba	16	14	777,000
New Brunswick	10	10	516,000
Newfoundland	7	7	361,000
Nova Scotia	13	12	643,000
Ontario	83	85	4,598,000
P. E. Island	4	4	98,000
Quebec	73	75	4,056,000
Saskatchewan	20	17	832,000
Yukon	1	1	9,000
N. W. Territories	0	1	16,000
Total	262	265	14,011,000

1. Which provinces elected more representatives than they had in the previous House of Commons? Which elected fewer?

2. If representation in the House of Commons is one member for each 50,000 of population, calculate from the populations given the number of representatives each province should have. Compare each result with the table above.

★ 3. See if you can find out why P.E.I. has more members than were obtained from your calculation.

Practise What You Have Learned

1. $\begin{array}{r} 738 \\ 459 \\ 2907 \\ 64 \\ 538 \\ \underline{4725} \end{array}$

2. $\begin{array}{r} 73{,}025 \\ \underline{-\,65{,}028} \end{array}$

3. $\begin{array}{r} 8\frac{1}{4} \\ \underline{-\,3\frac{7}{8}} \end{array}$

4. $\begin{array}{r} 604 \\ \underline{\times 508} \end{array}$

5. $\begin{array}{r} 7\frac{2}{3} \\ 4\frac{5}{6} \\ 6\frac{1}{2} \\ \underline{2\frac{3}{4}} \end{array}$

6. $17\overline{)9014}$

7. $\begin{array}{r} 68 \\ \underline{\times 7\frac{2}{3}} \end{array}$

8. $360\overline{)24935}$

9. $274\overline{)16345}$

10. $4\frac{1}{2} \times 3\frac{1}{3} =$

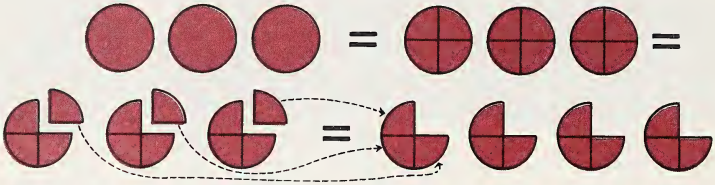
11. $\frac{7}{8} \times 12\frac{2}{3} =$

12. Round off 7499 to the nearest thousand.

Important Points in Division of Fractions

A. To divide by a fraction, invert the fraction and multiply.

1. Divide 3 by $\frac{3}{4}$.



Use the diagram to show that we can take $\frac{3}{4}$ circle out of 3 whole circles 4 times.

$3 \div \frac{3}{4} =$

$3 \times \frac{4}{3} = 4$

Why should the quotient of 3 divided by $\frac{3}{4}$ be more than the quotient of 3 divided by 1?

2. Divide $\frac{3}{4}$ by $\frac{2}{3}$.

$\frac{3}{4} \div \frac{2}{3} =$

$\frac{3}{4} \times \frac{3}{2} = ?$

a. Which fraction is the divisor? What is the inverted form of this fraction?

b. Which fraction is larger, $\frac{3}{4}$ or $\frac{2}{3}$?

c. When the dividend is larger than the divisor, will the quotient be more than 1 or less than 1?

B. To divide a fraction by a whole number, multiply the fraction by the number inverted.

3. Divide $\frac{3}{5}$ by 2.

$\frac{3}{5} \div 2 =$

$\frac{3}{5} \times \frac{1}{2} = ?$

a. Dividing by 2 is the same as multiplying by what fraction?

b. Complete the solution.

c. How can we tell that the answer must be less than 1?

C. To divide by a mixed number, change it to an improper fraction, invert this fraction, and multiply.

4. Divide $1\frac{1}{2}$ by $2\frac{1}{4}$.

$1\frac{1}{2} \div 2\frac{1}{4} =$

$\frac{3}{2} \div \frac{9}{4} =$

$\frac{3}{2} \times \frac{4}{9} = ?$

a. Explain each step in the solution.

b. Complete the solution.

c. How can we tell that the answer must be less than 1?

MORE PRACTICE

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Diagnostic Test in Division of Fractions

Divide. Express answers in simplest form.

	a	b	c	d	
I.	$16 \div \frac{4}{5} =$	$7 \div \frac{2}{3} =$	$9 \div \frac{6}{7} =$	$10 \div \frac{3}{4} =$	(364)
II.	$\frac{3}{4} \div \frac{3}{8} =$	$\frac{4}{5} \div \frac{5}{6} =$	$\frac{3}{4} \div \frac{3}{4} =$	$\frac{7}{8} \div \frac{5}{6} =$	(364)
III.	$\frac{3}{4} \div 2 =$	$\frac{7}{8} \div 3 =$	$\frac{4}{5} \div 4 =$	$\frac{2}{3} \div 8 =$	(364)
IV.	$2\frac{1}{2} \div 4 =$	$6\frac{1}{2} \div 3 =$	$5 \div 2\frac{1}{2} =$	$6 \div 9\frac{1}{3} =$	(364)
V.	$1\frac{1}{2} \div 3\frac{1}{3} =$	$3\frac{1}{3} \div 1\frac{1}{2} =$	$2\frac{1}{3} \div 1\frac{1}{6} =$	$4\frac{7}{8} \div 5\frac{1}{2} =$	(364)
VI.	$3 \div 7 =$	$9 \div 12 =$	$5 \div 16 =$	$16 \div 24 =$	(364)

Check your answers with those given on page 351. If you had more than one example incorrect in any group, review the Study Helps on page 34. For practice, turn to the page number in parentheses.

★Another Way to Divide by a Fraction

You know that $4 \div \frac{1}{2} = 8$. This quotient may be found by inverting $\frac{1}{2}$ and then multiplying 4 by 2. Likewise, the quotient may be found by changing 4 to halves, or $\frac{8}{2}$, and then dividing by $\frac{1}{2}$.

$$4 \div \tfrac{1}{2} = \tfrac{8}{2} \div \tfrac{1}{2} = \tfrac{8 \div 1}{2 \div 2} = \tfrac{8}{1} = 8$$

To divide by a fraction, change the numbers to be divided, so that both will be expressed with the same denominator. Then divide numerator by numerator and denominator by denominator. Since the quotient of the denominators will always be 1, we need divide only the numerators.

Tell how the following examples were worked:

1. $5 \div \frac{2}{3} = \frac{15}{3} \div \frac{2}{3} = \frac{15 \div 2}{3 \div 3} = \frac{15}{2} = 7\frac{1}{2}$
2. $\frac{1}{2} \div \frac{3}{4} = \frac{2}{4} \div \frac{3}{4} = \frac{2 \div 3}{4 \div 4} = \frac{2}{3}$

Use the method shown to divide each of the following:

3. $4 \div \frac{2}{3}$	5. $\frac{5}{6} \div 2$	7. $\frac{1}{2} \div \frac{2}{3}$	9. $1\frac{1}{2} \div \frac{2}{3}$
4. $12 \div \frac{4}{5}$	6. $\frac{3}{8} \div 3$	8. $\frac{5}{6} \div \frac{5}{8}$	10. $\frac{7}{8} \div 2\frac{1}{2}$

A Fraction as a Ratio

Two quantities can be compared by subtraction or by division.

1. How many disks are there in stack **a**? How many in stack **b**?

2. How many fewer disks are there in stack **a** than in stack **b**? Did you compare the two amounts by subtraction or by division?

The number of disks in stack **a** can be compared with the number in stack **b** by division. The fraction $\frac{3}{5}$ shows the **ratio** of the number in **a** to the number in **b**.

In the same way, the number of disks in stack **b** can be compared with the number in stack **a**. The ratio is $\frac{5}{3}$ or $1\frac{2}{3}$. A ratio shows how many times as large one number is as another number. A ratio may be expressed as a proper fraction, such as $\frac{3}{5}$; as an improper fraction, such as $\frac{5}{3}$, which is equal to the mixed number $1\frac{2}{3}$; or as a whole number, such as 2. Thus, the ratio of 2¢ to 1¢ is $\frac{2}{1}$ or 2.

We read the ratio $\frac{3}{5}$ as "three-fifths" or as "3 to 5."

3. What is the ratio of **a** to **b** in **II**?

4. To find the ratio of **a** to **b** in **III**, express each coin as cents. Give the ratio of a nickel to a dime; of a dime to a nickel.

5. Find the ratio of **a** to **b** in **IV**; in **V**.

6. Find the ratio of **b** to **a** in **IV**; in **V**.

Find the ratio of **a** to **b** in each of the following:

	a	b		a	b
7.	4 in.	8 in.	13.	25¢	50¢
8.	2 ft.	1 yd.	14.	10 fl.oz.	1 pt.
9.	1 pt.	1 gal.	15.	10 min.	1 hr.
10.	6 oz.	1 lb.	16.	25 sec.	1 min.
11.	3 qt.	1 pt.	17.	1 da.	8 hr.
12.	1 bu.	3 pk.	18.	440 yd.	1 mi.

MORE PRACTICE

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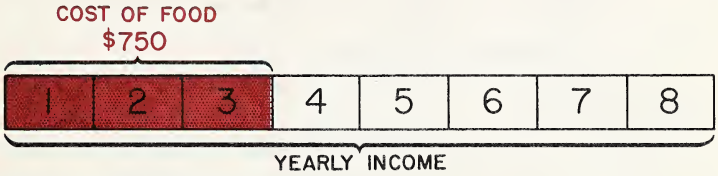
Finding a Number When a Fractional Part of It Is Given

1. The Johnson family spends $\frac{3}{8}$ of its income for food. If the cost of food for this family is \$750 a year, what is the family income?



2. Into how many parts is the diagram divided? How many of the parts represent the cost of food? the yearly income?

3. How much money does each of the parts represent?

4. What is the yearly income?

The solution represented by the diagram is as follows:

If $\frac{3}{8}$ of the yearly income = \$750
Then $\frac{1}{8}$ " " " " = \$250 (\$750 ÷ 3)
Hence $\frac{8}{8}$ " " " " = \$2000 (8 × \$250)

Find the missing number when:

5. $\frac{3}{5}$ of it = 24
6. $\frac{7}{8}$ of it = 35
7. $\frac{3}{10}$ of it = 72
8. $\frac{4}{5}$ of it = 26
9. $\frac{5}{8}$ of it = 37
10. $\frac{1}{2}$ of ? = $6\frac{1}{4}$
11. $\frac{2}{5}$ of ? = $3\frac{1}{3}$
12. 75 = $\frac{5}{6}$ of ?
13. 45 = $\frac{9}{16}$ of ?
14. $\frac{7}{12}$ of ? = 63
15. $\frac{11}{12}$ of ? = 55
16. $8\frac{2}{3} = \frac{2}{3}$ of ?
17. $\frac{3}{4}$ of ? = $2\frac{1}{2}$
18. $\frac{2}{3}$ of ? = $1\frac{1}{2}$
19. $\frac{5}{6}$ of ? = 2

20. A tank $\frac{5}{8}$ filled contains 720 gallons. How many gallons will the tank contain when filled?

21. In a city election only $\frac{2}{3}$ of the registered voters cast ballots. If there were 7152 votes cast, how many voters were there? How many of the votes cast represent a majority?

★22. Show that finding a number when a fractional part of it is given is the same as multiplying the number given by the fraction inverted.

MORE PRACTICE

We May Multiply and Divide Measurements

1. Multiply 3 ft. 8 in. by 4.

$$\begin{array}{r} 3 \text{ ft. } 8 \text{ in.} \\ \times 4 \\ \hline 12 \text{ ft. } 32 \text{ in.} \end{array} = 12 \text{ ft.} + 2 \text{ ft. } 8 \text{ in.} = 14 \text{ ft. } 8 \text{ in.}$$

How do we change 32 in. to feet?

2. Show that 3 ft. 8 in. $= 3\frac{2}{3}$ ft. Check the example by multiplying $3\frac{2}{3}$ ft. by 4.

3. Diane said that she could work the example by changing 3 ft. 8 in. to inches and then multiplying by 4. Show how to work the example by this method.

Multiply the following measurements as in problem 1 and check by the method given in either problem 2 or 3.

4. 5 lb. 6 oz. $\times 2$

5. 1 hr. 18 min. $\times 3$

6. 2 gal. 3 qt. $\times 3$

7. 2 pt. 12 fl.oz. $\times 3$

8. 3 qt. 1 pt. $\times 4$

9. 2 ft. 9 in. $\times 5$

10. Divide 5 ft. 8 in. by 2.

$$2\overline{)5 \text{ ft. } 8 \text{ in.}} = \begin{array}{r} 2 \text{ ft. } 10 \text{ in.} \\ \hline 2\overline{)4 \text{ ft. } 20 \text{ in.}} \end{array}$$

How do we change 5 ft. 8 in. to 4 ft. 20 in.?
Why was the change made?

11. Express 5 ft. 8 in. as feet and divide this mixed number by 2.

12. Ralph said that he would change 5 ft. 8 in. to inches and then divide by 2. Show that this method may be used to work the example.

Divide each of the following and check the solution by the method described in either problem 11 or 12.

13. $2\overline{)5 \text{ qt. } 1 \text{ pt.}}$

14. $3\overline{)7 \text{ ft. } 9 \text{ in.}}$

15. $4\overline{)10 \text{ lb. } 2 \text{ oz.}}$

16. $2\overline{)1 \text{ pt. } 12 \text{ fl.oz.}}$

17. $4\overline{)6 \text{ bu. } 2 \text{ pk.}}$

18. $5\overline{)16 \text{ min. } 10 \text{ sec.}}$

MORE PRACTICE

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Practice Test in the Fundamentals

I. Add and check:

1.	2.	3.	4.	5.
72	803	49	$7\frac{1}{2}$	$3\frac{1}{2}$
39	925	238	$2\frac{3}{4}$	$2\frac{5}{6}$
54	168	56	$4\frac{7}{8}$	$1\frac{2}{3}$
68	394	2875	$1\frac{5}{8}$	$8\frac{3}{4}$
87	708	493		

6.	7.	8.
4 ft. 7 in.	9 lb. 4 oz.	12 hr. 15 min.
1 ft. 9 in.	4 lb. 10 oz.	3 hr. 25 min.
3 ft. 2 in.	15 oz.	48 min.

II. Subtract and check:

1.	2.	3.	4.	5.
403	253	710	73,142	46,091
129	186	567	42,355	25,158

6.	7.	8.	9.	10.
3	$5\frac{7}{8}$	$9\frac{1}{2}$	$7\frac{3}{4}$	$19\frac{1}{4}$
$1\frac{3}{4}$	$1\frac{3}{4}$	$6\frac{2}{3}$	$1\frac{5}{6}$	$12\frac{2}{3}$

11.	12.	13.
6 lb. 3 oz.	5 gal. 1 qt.	3 hr. 12 min.
4 lb. 9 oz.	4 gal. 3 qt.	2 hr. 50 min.

III. Multiply and check:

1.	2.	3.	4.	5.
96	408	730	49	504
7	6	8	38	46

6.	7.	8.	9.	10.
823	760	906	470	96
57	80	308	500	$7\frac{3}{4}$

11. $\frac{3}{4} \times 18 =$ 12. $1\frac{1}{2} \times \frac{5}{6} =$ 13. $\frac{7}{8} \times \frac{3}{4} =$ 14. $2\frac{1}{4} \times 3\frac{1}{2} =$

15. Multiply each of the following by 3: 4 gal. 3 qt.; 15 min. 25 sec.

IV. Divide and check:

1.	2.	3.	4.
$7\overline{)3145}$	$8\overline{)5035}$	$9\overline{)4112}$	$36\overline{)1447}$

5.	6.	7.	8.
$28\overline{)8531}$	$48\overline{)9627}$	$540\overline{)7256}$	$180\overline{)37125}$

9. $72 \div \frac{8}{9} =$ 10. $\frac{4}{5} \div \frac{2}{3} =$ 11. $16 \div 2\frac{1}{2} =$ 12. $1\frac{1}{4} \div 2\frac{1}{4} =$

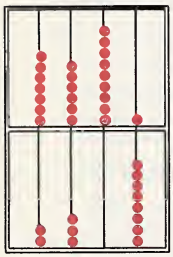
How Well Do You Remember?

1. Use each of the digits 1, 3, 6, and 8 once and write the largest number possible when 8 is in tens' place.

2. Use the digits in problem 1 and write the largest and the smallest possible four-place whole numbers. What is the difference between these numbers?

3. The value of the 2 in 245 is how many times as much as the 2 in 102? How many times as much as the 2 in 120?

4. In a number, if a 5 is six places to the left of ones' place, what is the value of the 5?



5. A billion is how many times as large as a million? as a thousand?

6. What number is shown on the abacus?

7. Find the sum of the following numbers without writing them in a column:

$$476 + 348 + 295 + 603 + 957 =$$

8. Round off, to the nearest thousand:

72,560; 99,500; 38,499

9. A number rounded off to the nearest hundred is 7300. Before the number was rounded off, what could have been its greatest value? What could have been its least value?

10. Find the smallest common denominator of three fractions having denominators of 4, 6, and 8; of 6, 8, and 12; of 5, 10, and 15.

11. Write a fraction, greater than $\frac{1}{4}$ but less than $\frac{2}{5}$, with a numerator of 1.

12. A city having a population of 45,000 uses 2,340,000 gallons of water a day. What is the average number of gallons used by each person in a day?

13. Mr. Harris bought a new car for $3000. If he was given an allowance of $750 for his old car, what was the ratio of the allowance to the cost of the new car?

14. A bill passed the House of Commons by a majority vote when 254 members voted. What was the least number of members who voted for the bill in order for it to be passed?

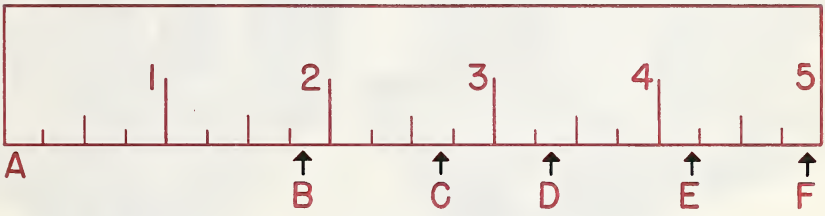
Chapter Test

Work the following:

1. $\begin{array}{r} 708 \\ \times 9 \\ \hline \end{array}$ 2. $27\overline{)5240}$ 3. $\begin{array}{r} 8\frac{1}{2} \\ -3\frac{5}{6} \\ \hline \end{array}$ 4. $\begin{array}{r} 58 \\ \times 4\frac{2}{3} \\ \hline \end{array}$ 5. $2\frac{1}{2} \div 3\frac{1}{4} =$

6. Beginning with the smallest fraction, arrange the following fractions according to value: $\frac{1}{2}, \frac{3}{4}, \frac{2}{3}, \frac{5}{8}, \frac{1}{6}, \frac{7}{12}$.

7. Write a fraction greater than $\frac{1}{3}$, but less than $\frac{1}{2}$, with a numerator of 2.



8. The illustration shows part of a foot ruler. What is the length of the smallest division shown on the ruler?

9. To the nearest half inch, give the length of a line which extends from A to B; from A to C; from A to D; from A to E; from A to F.

10. To the nearest dollar, find the average of the following amounts: $136, $148, $156, $204, $193, and $246.

11. The yearly cost of operating the schools in a city having a population of 25,000 is $762,500. To the nearest dollar, what is the average cost of the schools a person?

12. How many ribbons each $1\frac{1}{4}$ yards long can be cut from a ribbon 10 yards long?

13. Five years ago a man's salary was $2500, but today it is $4000. What is the ratio of his salary 5 years ago to his salary today?

14. A family spends $\frac{3}{10}$ of its income for food. If the yearly cost of their food is $975, what is the yearly income of the family?

A
B
C
D
E
F
G
H

CHAPTER II

Decimal Fractions

The illustrations on page 42 show how a **cube** may be used to form another cube. A cube is a figure in which length, width, and thickness are all equal. Use the picture in answering the following questions:

1. What number does cube A represent? What number does the row of cubes in B represent? What number does the layer of cubes in C represent? What number does cube D represent?

2. How many layers of cubes are there in cube D?

3. How many rows of cubes are there in cube D?

4. Cube A is what fractional part of a row of cubes? What fractional part of a layer of cubes is it? What fractional part of a large cube is it?

5. What number does cube E represent? What number does a layer of cubes in F represent? What number does a row of cubes in G represent? What number does cube H represent?

6. How many cubes of the size of the cube in H does it take to make a row of these cubes to fit in the cube in E? to make a layer of these cubes to fit in the cube in E?

7. Cube H is what fractional part of a row of these cubes as shown in G? What fractional part of a layer of these cubes as shown in F is it? Cube H is what fractional part of cube E?

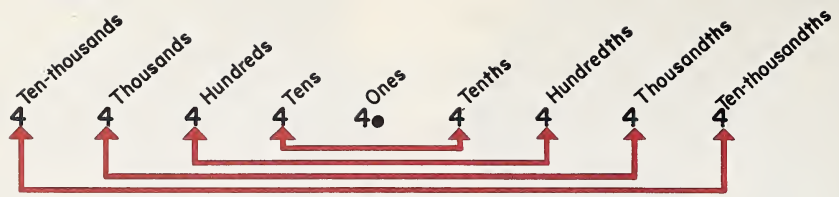
8. How many times as large as 2 is 20? 200? 2000?

9. Two is what fractional part of 200? of 2000? of 20,000?

10. How many times as large as .003 is .03? .3? 3?

11. What fractional part of 3 is .03? .003? .0003?

12. Use the picture below to show why the base of our number system is 10.



Our Number System Is a Decimal System

1. Give the name of the place in our number system which is one place to the right of ones' place; two places to the right of ones' place; three places to the right of ones' place; five places to the right of ones' place.

2. Give the name of the place in our number system which is one place to the left of ones' place; two places to the left of ones' place; three places to the left of ones' place; five places to the left of ones' place.

3. What value has the 4 shown above, which is one place to the right of ones' place? two places to the right of ones' place? three places to the right of ones' place? Write each of these numbers with figures.

4. How many times as much as the value of the 4 in tenths' place is the value of the 4 in tens' place?

5. How many times as much as the value of the 4 in hundredths' place is the value of the 4 in hundreds' place?

6. The value of the 4 in tenths' place is what fractional part of the value of the 4 in tens' place?

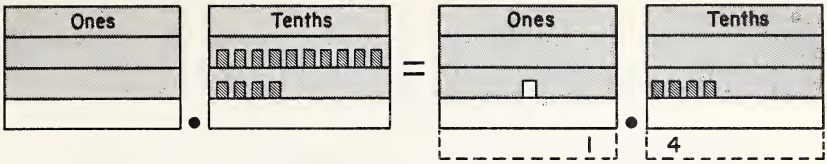
7. The value of the 4 in hundredths' place is what fractional part of the value of the 4 in ones' place? of the value of the 4 in tens' place? of the value of the 4 in hundreds' place?

8. In the illustration, the value of a 4 in any place is what fractional part of the value of a 4 one place to the left?

9. In the illustration, the value of the 4 in each place is how many times the value of the 4 in the next place to its right?

10. By what amount is the value of a figure in a number multiplied when it is moved to the left 2 places? to the left 3 places?

11. By what amount is the value of a figure in a number divided when it is moved one place to the right? four places to the right?



Numbers May Be Regrouped

1. In the left-hand place-value chart, how many tenths do the cards represent? In the other place-value chart, these cards are regrouped to represent what number? 14 tenths is equal to what other number?

2. Write the number of tenths which is equal to 3.2; to 13.5; to 1.1.

3. Regroup as tenths and ones so as to have the greatest number of ones possible: 75 tenths; 92 tenths.

4. Regroup as ones and hundredths: 150 hundredths; 175 hundredths.

5. How many tens are there in 25?

$$25 = 2 \text{ tens and } 5 \text{ ones} = 2\tfrac{5}{10} \text{ tens} = 2.5 \text{ tens}$$

6. Express as tens: 375; 105; 1125; 128.

7. Express as hundreds: 1750; 2145; 10,250.

8. Express as thousands: 47,500; 325,500; 833,250.

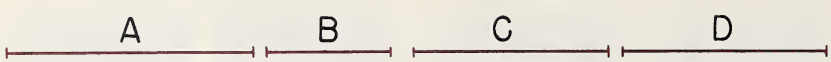
9. Express as millions: 3,500,000; 25,450,000.

10. Recently the federal government spent 17.5 billion dollars for military arms. Write this number with figures.

$$17.5 \text{ billion} = 17 \text{ billion} + .5 \text{ billion}$$
$$17 \text{ billion} = 17{,}000{,}000{,}000$$
$$.5 \text{ billion} = \tfrac{5}{10} \times 1{,}000{,}000{,}000 = 500{,}000{,}000$$
$$17.5 \text{ billion dollars} = \$17{,}500{,}000{,}000$$

11. Write each of the following with figures:

a. 41.2 billion dollars
b. 1.8 billion gallons
c. 23.6 million miles
d. 207.5 billion dollars
e. 31.4 million pupils
f. 150.6 million people



Comparing Decimal Fractions

It is very easy to see that line A is longer than line B, but it is difficult to decide whether line C is longer or shorter than line D. Measure these two lines to see which is longer.

It is easy to see that .8 is larger than .3, but close examination is required to see if .7342 is larger or smaller than .7345. The first three figures in these two four-place decimal fractions are the same, but the fourth figure in each differs. The figure in fourth place enables us to decide which number is larger. Which is larger?

1. Beginning with the smallest, arrange the following according to value: .7, .38, 1.1, .049.

Just as we express common fractions as their equivalent fractions with a common denominator in order to compare them, so also we can express decimal fractions as equivalent fractions having a common denominator. Doing this means having an equal number of decimal places in each number. Since the greatest number of decimal places in any of the numbers on the right is three places, as in .049, each number should be expressed as having the same number of decimal places as shown on the right. Arrange the fractions according to value.

.7 = .700
.38 = .380
1.1 = 1.100
.049 = .049

Arrange according to value, beginning with the smallest:

2. .5, 1.2, .07, .965
3. .08, .084, .19, 1.9
4. .72, .59, .09, .436
5. .723, .7223, .7213, .732
6. .421, .124, .241, .412
7. .358, .835, .853, .583
8. .104, .401, .41, 1.41
9. .6314, .6304, .643, .6413

★10. Using each of the digits 1, 2, and 5 but once in each, write the following:

a. The largest decimal fraction possible.

b. The smallest decimal fraction possible.

c. The smallest decimal fraction in which 5 is in tenths' place.

d. A decimal fraction which is larger than .5 but smaller than .52.

Rounding Off Decimal Fractions

The same rules which govern rounding off of whole numbers apply to rounding off of decimals. Study the following samples:

A. To the nearest tenth, what is the value of .74? of .76?

.74 to the nearest tenth is .7, but .76 to the nearest tenth is .8. Why was the 7 changed to 8 in the second number but not in the first number?

B. To the nearest thousandth, what is the value of .3814? of .3815?

.3814 to the nearest thousandth is .381, but .3815 to the nearest thousandth is .382. Why was the 1 changed to 2 in the second number but not in the first number?

1. Make a rule for rounding off a decimal.

2. The value of .63 to the nearest 0.1 is .6. The decimal 0.1 indicates in this case that a number is rounded off to the nearest tenth. How is it possible to express the statement that a number is to be rounded off to the nearest hundredth? to the nearest thousandth?

3. Round off each of the following to the nearest 0.1:

a. 65 b. .725 c. .449 d. .375 e. .05 f. .95

4. Round off each of the following to the nearest 0.01:

a. 345 b. .354 c. .6949 d. .6954 e. .995 f. 2.9949

5. When a two-place decimal fraction was rounded off to the nearest 0.1, its value was .7. The least value this decimal could have had was .65. What was the greatest value it could have had?

Practise What You Have Learned

1. $4\frac{1}{2}$ / $3\frac{5}{6}$ / $2\frac{3}{4}$ / $6\frac{2}{3}$

2. $72{,}560 - 18{,}937$

3. $460\overline{)92375}$

4. 706×308

5. $6\frac{1}{4} - 1\frac{2}{3}$

6. $54 \times 9\frac{3}{4}$

7. $18\overline{)4163}$

8. $60 \div \frac{3}{8} =$

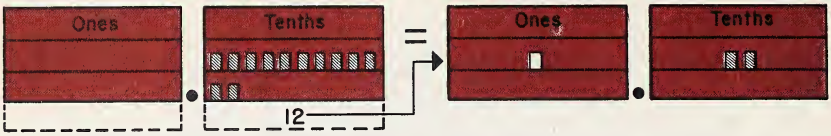
9. $87\frac{1}{2} \times 6$

10. $\frac{7}{8}$ of $150 =$

11. $2\frac{1}{4} \div \frac{3}{8} =$

12. $\frac{5}{6} \times 1\frac{1}{2} \times \frac{3}{4} =$

13. $2\frac{1}{4} \div 3 =$



Important Points about Addition and Subtraction of Decimals

Points to be observed in addition and subtraction of decimals:

A. We add and subtract decimals in the same way that we add and subtract whole numbers. See example **1**.

B. Only numbers of like values may be added or subtracted. Thus, tenths may be added to tenths, hundredths to hundredths, and other like values may be combined. See example **2**.

1. Find the sum of .4 and .8.

.4
.8
1.2

Use the diagram to show how to regroup the sum.

2. Find the sum of .3 and .45.

.3 = .30
.45 = .45
.75

Since .45 is expressed as hundredths, change 3 tenths to 30 hundredths, or .30, and then add. Check the solution by use of common fractions.

MORE PRACTICE

3. From .42 subtract .35.

.42
.35

Show by approximation that the answer must be less than .1. Think, ".42 is a little more than .4 and .35 is a little less than .4."

4. From 1.4 subtract .55.

1.4 = 1.40
.55 = .55
.85

a. Why was 1.4 changed to 1.40?
b. How can we tell by inspection that the answer must be less than 1?

5. Find the sum of .738, .194, and .256. Show by approximation that your answer is sensible.

.738
.194
.256

To find the approximate answer, round off each number to a one-place decimal. Think, ".7 + .2 + .3 = 1.2." Find the exact sum and show that the answer is sensible.

377
378

Diagnostic Test in Addition and Subtraction of Decimals

Find the sums:

	a	b	c
I.	.7	.56	3.72
(365)	.9	.93	4.56
	.8	.85	9.04
	.4	.54	2.30

	a	b	c
II.	.725	.456	2.965
(365)	.456	.325	0.148
	.380	.129	1.837
	.165	.378	5.246

	a	b	c
III.	.04	.076	.420
(365)	.02	.025	.560
	.03	.040	.980
	.05	.029	.750

	a	b	c
IV.	3.5	2.84	.72
(365-	1.46	.98	.48
366)	2.29	1.7	.37
	4.6	4.65	.9

Subtract and check:

	a	b	c
I.	.65	7.72	6.42
(366)	.32	3.56	2.84

	a	b	c
II.	.576	.805	6.745
(366)	.359	.308	5.852

	a	b	c
III.	.723	.946	.075
(366)	.658	.855	.068

	a	b	c
IV.	7.2	4.01	6
(366)	3.95	3.965	4.18

Check your answers with those given on page 352. If you had more than one example incorrect in any group, review the Study Helps on page 48. For practice, turn to the page number given in the parentheses.

★For Those Who Made No Errors on the Above Tests

1. From a *World Almanac* or some other reference book, find the world's record time for the 100-yard dash.

2. The speed of a ship is given in **knots.** One knot is equal to one nautical mile per hour. How many feet are there in a nautical mile? (See page 349.) If the speed of a ship is 28 knots, about how many miles per hour does the ship travel? Show that a knot is equal to about $1\frac{1}{7}$ m.p.h.

Reading an Altimeter

A pilot measures the altitude (height of his airplane above sea level) with an altimeter. The diagram on the left shows the dial of an altimeter.

The short hand of the altimeter represents the number of thousands of feet and the long hand represents the number of hundreds of feet.

1. The short hand points between which two numbers?

Since this hand represents thousands, the height recorded is between 4000 feet and 5000 feet.

2. The long hand points to how many spaces beyond 8?

Since this hand represents hundreds, the hand points to the number 820.

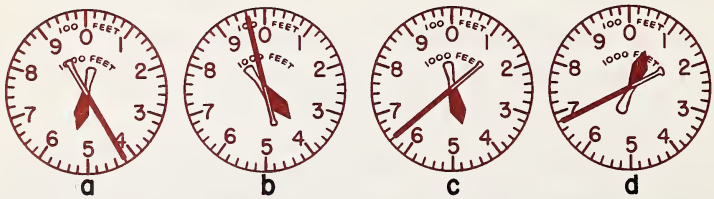
3. Show that the height represented on the dial is 4820 feet.

4. How many small divisions are there on the dial between any given number and the next number? Show that each of these small divisions represents $\frac{1}{5}$ or .2 of a whole space between any number and the next number.

5. If the figure 1 on the dial represents 100 feet, what does 9 represent? What does $1\frac{2}{5}$ represent? What does $3\frac{4}{5}$ represent? What does 7.6 represent?

6. If the figure 1 on the dial represents 1000 feet, how many feet does each small division between 1 and 2 represent? How many feet are there in $1\frac{2}{5}$ spaces? How many feet in 7.5 spaces?

7. Give the height of an airplane if the reading on the altimeter is as follows:



★8. Make a copy of a dial of an altimeter and show the position of the hands to give a reading of 7460.

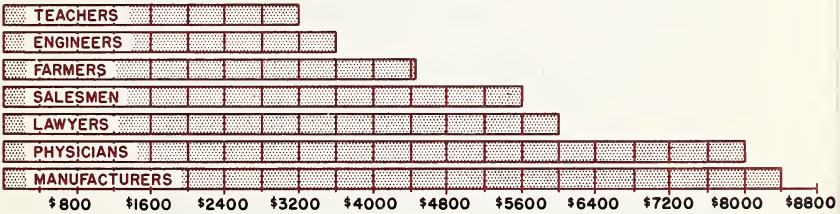
How Much Will You Be Able to Earn?

The graph below shows the results of a study made of the average lifetime earnings of the people in Canada. Three groups were formed according to the amount of schooling the people had had. The average lifetime earnings were computed on the basis of all earnings from the time they finished their schooling to age 60.

1. Approximately how much were the average lifetime earnings of a college graduate? of a high school graduate? of an untrained person?

2. At an average of 40 years of employment, what were the average yearly earnings of the college graduates? of the high school graduates? of the untrained group? (Express to the nearest $50.)

3. A study by a large eastern university showed that the average earnings of its graduates 10 years after graduation were as follows:



Each square in a bar represents how many dollars?

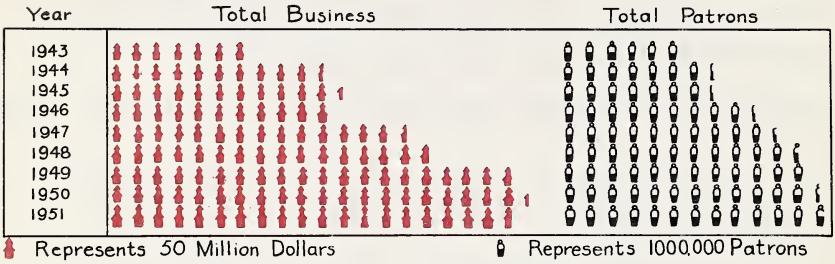
4. Approximately what were the yearly earnings of manufacturers? of physicians? of salesmen? of teachers?

5. The average yearly earnings of teachers were less than half the yearly earnings of how many of the professional groups shown?

6. The average yearly earnings of engineers were less than half the yearly earnings of how many of the professional groups shown?

Growth of Co-operatives in Canada

Canadian Co-operatives are prominent in the field of marketing agricultural products and supplying consumers with goods. Grain, dairy products, live stock, eggs and poultry, fruit and vegetables are the principal products marketed co-operatively. The graph shows the growth of the total business done by co-operatives in Canada in the years indicated.



1. How many dollars' worth of business is represented by each symbol in column 2? How many patrons are represented by each symbol in column 3?

2. To the nearest million, what was the total value of business done by the Co-operatives in 1943; in 1946; in 1949; in 1950?

3. To the nearest 100,000, how many patrons were there in 1944; in 1947; in 1949?

4. For the period given, in which year was the total business the greatest? The total number of patrons greatest?

5. The total value of the business done in 1950 was approximately one billion dollars. In 1944 the total business done was approximately one-half billion dollars. The total business done in 1950 was how many times the total business done in 1944?

6. In 1950 the total number of patrons was 12.2 million. Write this number in figures.

7. In 1950 the average number of patrons per Co-operative was 480, about how many co-operatives were there in Canada in that year?

★8. Find out from your local Co-operative how you can become a patron. What privileges do patrons enjoy?

Practise What You Have Learned

1. .746
   .358
   .967
   .695

2. 71,345
   −42,678

3. 806
   ×409

4. $5\frac{1}{2}$
   $-3\frac{5}{6}$

5. $9\overline{)4113}$

6. $27\overline{)1846}$

7. .534
   −.528

8. 96
   $\times 4\frac{7}{8}$

9. $17\frac{1}{3}$
   $+9\frac{3}{4}$

10. $56 \div \frac{2}{3} =$

11. $\frac{7}{8}$ of 116 =

12. $\frac{3}{4} \times \frac{5}{8} =$

13. $\frac{1}{2} \div \frac{3}{4} =$

14. $1\frac{1}{2} \div 2\frac{2}{5} =$

15. $\frac{3}{4} \times 1\frac{1}{2} \times 2\frac{3}{4} =$

16. $6\frac{1}{4} \div 4 =$

17. To the nearest 0.01, give the value of 3.1416; of .0749.

Number Quickies

1. A barrel of potatoes weighs 165 lb. and a bushel of potatoes weighs 60 lb. How many bushels of potatoes are there in a barrel? How many pecks of potatoes are there in a barrel?

2. A box contains 216 oranges. What is the total value at 35¢ a dozen?

3. It takes $10\frac{8}{9}$ bu. of oats to make a barrel (196 lb.) of oatmeal. At that rate, 1 bu. of oats makes how many pounds of oatmeal?

4. A car has a speed of 60 m.p.h. At that rate, how many feet does the car travel in one second?

5. How many minutes are there in .4 hours?

6. What fractional part of an hour is 18 minutes?

7. Write 9 min. 36 sec. as minutes.

8. What is the largest four-place number which may be written with the digits 1, 3, and 4 with only one digit repeated?

9. A number is divisible by 9 when the sum of its digits is divisible by 9. Find the missing digit in 34?7 if the number is to be divisible by 9.

10. How many days are there from Jan. 1, 1954 to Jan. 1, 1955?

11. A box contains 12 candy bars, each weighing $4\frac{1}{2}$ oz. How many pounds of candy are there in the box?

12. How many hundredths are there in 3.4?

Multiplying a Decimal and a Whole Number

1. The golf course at which Jim caddies is 4.7 miles from his home. If he rides this distance each way to and from the course, how far does he travel?

a. Show by approximation that the product must be less than 10.

$$\begin{array}{r} 4.7 \\ \times 2 \\ \hline 9.4 \end{array}$$

b. Give another way besides multiplication to find the distance traveled.

c. Check the answer by use of common fractions.

Jim rides 9.4 miles on a round trip.

2. Explain the placement of the point in the following examples.

a.	b.	c.	d.
.38	4.26	.725	.35
$\times 3$	$\times 4$	$\times 3$	$\times 4$
1.14	17.04	2.175	1.40

3. Explain how the products are found in the following examples:

A. $30 \times 7 = 210$
B. $3 \times 7 = 21$
C. $.3 \times 7 = 2.1$
D. $.03 \times 7 = .21$

a. In A, 7 is multiplied by 30. By what number is 7 multiplied in each of the other examples on the left?

b. Each succeeding multiplier is what part of the preceding multiplier?

c. Each succeeding product is what part of the preceding product?

4. Rita said, "3×5 has the same product as 5×3. Then $5 \times .3$ has the same product as $.3 \times 5$." What is the product of $5 \times .3$? of $.3 \times 5$?

Problems 1 and 3 show that **there are as many decimal places in the product of a decimal and a whole number as there are decimal places in the given numbers.**

Find the product of each of the following. Then show by approximation that your answer is sensible.

5. $6 \times .7 =$
6. $.4 \times 9 =$
7. $4 \times 1.8 =$
8. $1.5 \times 4 =$
9. $3 \times .75 =$
10. $.7 \times 35 =$

Multiplying Two Decimals

1. If a car averages 16.3 miles to a gallon of gasoline, how many miles should it travel if it uses 7.5 gallons of gasoline?

```
 16.3
×7.5
 815
1141
122.25
```

We multiply decimals as we do whole numbers.

a. Think, "16.3 is approximately 16 and 7.5 is approximately 8." What is the product of 8 and 16?

b. From your approximation, show that the answer to the example must be 122.25 and not 1222.5 or 12.225.

The car should travel 122.25 miles.

2. Tell how many decimal places there are in 16.3; in 7.5; in the product of 7.5 × 16.3.

The number of decimal places in the product is the same as the sum of the number of decimal places in the two numbers multiplied.

3. Apply the above rule to each of the following examples:

a.	b.	c.	d.
.34	.26	.25	.25
×.4	×.3	×.25	×.03
.136	.078	.0625	.0075

4. Show why it was necessary to insert a zero between the decimal point and the first figure in the product in **b** and **c** and two zeros in the product in **d**.

Find the product in each of the following examples. Then show by approximation that your answer is sensible.

	a	b	c
5.	1.2 × 2.4 =	3.6 × .12 =	.4 × 3.5 =
6.	.9 × 15.2 =	.03 × 1.5 =	2.7 × 1.5 =
7.	.7 × .4 =	.16 × .16 =	1.4 × .13 =
8.	.28 × .28 =	.32 × .32 =	2.6 × 3.4 =
9.	7.5 × .75 =	.55 × .55 =	.4 × .07 =

10. A small car averages 32.8 miles to a gallon of gasoline. At that rate, how many miles should the car travel when it consumes .75 gal.? 3.5 gal.? 4.6 gal.?

★Finding the Position of the Point in the Product by Approximation

In the following examples, each product is given with the decimal point missing. Find the position of the point by approximation. Study the samples to find the method to use.

A. $.32 \times 6.8 = 2176$. (Decimal point missing in product.)

Round off .32 to .3 and 6.8 to 7. The product of .3 and 7 is 2.1. The product of .32 and 6.8 is equal to approximately 2.1. Hence the exact value is 2.176.

B. $.42 \times .025 = 1050$. (Decimal point missing in product.)

Round off .42 to .4 and .025 to .03. The product of .4 and .03 ($\frac{4}{10} \times \frac{3}{100} = \frac{12}{1000}$) is .012, or approximately .01. It follows, then, that the product of .42 and .025 is about .01, or .0105.

C. $.045 \times .76 = 3420$. (Decimal point missing in product.)

Round off .045 to .05 and .76 to .8. The product of .05 and .8 ($\frac{5}{100} \times \frac{8}{10} = \frac{40}{1000}$) is .040, or .04. The product of .045 and .76 is equal to approximately .04. Hence the exact value is .0342. Check by use of the rule on page 55.

When the number to be rounded off is greater than 1, round off the number to the nearest whole number, such as 3.46 to 3.

When the number to be rounded off is less than 1, round off the number to the first decimal place which is held by any digit except zero, such as .024 to .02.

Find, by approximation, the position of the decimal point in each of the following examples. Check by use of the rule on page 55.

	a	b	c
1.	$.16 \times .32 = 512$	$.25 \times 4.5 = 1125$	$.05 \times 3.64 = 1820$
2.	$2.7 \times .27 = 729$	$.14 \times .014 = 196$	$35 \times .035 = 1225$
3.	$.025 \times 1.8 = 450$	$3.6 \times .36 = 1296$	$.01 \times .48 = 48$
4.	$7.2 \times 1.25 = 9000$	$.15 \times 1.6 = 240$	$3.8 \times 42 = 1596$
5.	$.04 \times .175 = 700$	$.055 \times 4.6 = 2530$	$.1 \times .036 = 36$
6.	$.17 \times 17 = 289$	$2.4 \times 4.8 = 1152$	$.09 \times .15 = 135$
7.	$.44 \times 3.6 = 1584$	$.9 \times .075 = 675$	$.15 \times .25 = 375$

Multiplying and Dividing by 10, 100, and 1000

1. What is the value of 100 cans of soup at $.085 a can? What is the value of 1000 cans at the same price?

$$100 \times \$.085 = \$\ 8.500, \text{ or } \$8.50$$
$$1000 \times \$.085 = \$85.000, \text{ or } \$85.00$$

2. Study the changes in the product in each of the following groups:

$10 \times 35 = 350$	$10 \times .35 = 3.50$ or 3.5
$100 \times 35 = 3500$	$100 \times .35 = 35.00$ or $35.$
$1000 \times 35 = 35{,}000$	$1000 \times .35 = 350.00$ or $350.$

a. Write a rule for multiplying by 10, by 100, or by 1000.

b. Write a rule for placing the decimal point when multiplying a decimal fraction by 10, by 100, or by 1000.

3. Multiply each of the following numbers by 100. Multiply each by 1000.

a. 36	c. 102	e. 750	g. 400	i. 43,560
b. .75	d. .035	f. 5.64	h. .0255	j. 1.125

4. In the following examples, tell by what number each of the numbers in A must be multiplied to give the number in B:

A	B	A	B	A	B
a. 3.14	314	c. 45.6	456	e. .125	125
b. .025	2.5	d. .02	20	f. 3.1416	31.416

5. Study each of the following samples. Then write a rule for dividing a whole number and a decimal by 10, by 100, or by 1000.

$75 \div 10 = 7.5$	$7.5 \div 10 = .75$
$75 \div 100 = .75$	$7.5 \div 100 = .075$
$75 \div 1000 = .075$	$7.5 \div 1000 = .0075$

6. Divide each of the following numbers by 100. Divide each by 1000.

a. 96	c. .465	e. 8.5	g. .056	i. .9
b. 735	d. 960	f. 3.45	h. 12.5	j. .01

Crop Yield per Acre

The table gives the average yield per acre of certain important crops in this country for two different periods of time.

Crop	Average Yield	
	1891–1920	1921–1950
Barley	23.5 bu.	22.1 bu.
Rye	12.7 bu.	11.4 bu.
Flax	68.4 bu.	70.9 bu.
Hay	1.3 ton	1.3 ton
Oats	29.7 bu.	29.3 bu.
Wheat	14.1 bu.	14.3 bu.

1. In which of the crops was there an increase in the average yield an acre from the first period to the second period?

2. In which of the crops was there a decrease in the average yield an acre from the first period to the second period?

3. How many pounds of hay did the average acre of land produce in the first period? How many pounds in the second period?

4. At the rates given, find the number of bushels of rye produced on 100 acres in the first period; in the second period.

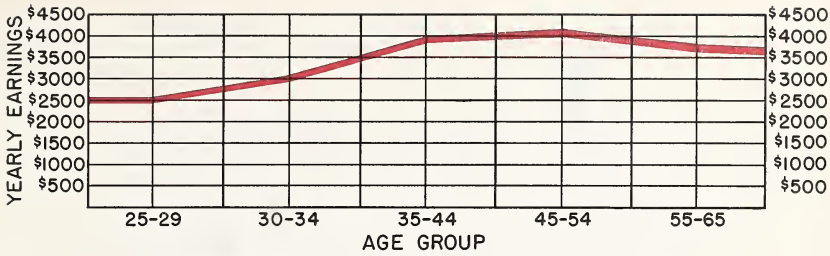
5. A farmer planted 100 acres of wheat. At the rates given, find the number of bushels he should have harvested in the first period; in the second period.

6. A bushel of oats weighs 32 pounds. To the nearest pound, find the number of pounds in the average yield an acre of oats for the first period; for the second period.

7. If a farmer planted 50 acres of rye each time, at the rates given, how much less rye would he have raised in the second period than in the first period?

8. To the nearest pound, what was the average yield of flax for the second period?

9. A load of hay weighs about 3 tons. From the table find about how many acres it took, on the average, to produce a load of hay.



How Can I Increase My Earnings?

1. How much money does one space along the left and right margins represent? This amount is the **scale** to which the graph is drawn. The numbers along the **vertical scales** on the left and right help us to read the graph.

2. How many different age groups are given along the **horizontal scale** at the bottom of the graph?

3. Find the average yearly earnings of the age group 25–29.

> Find the center of the age group 25–29 on the horizontal scale. From this point follow the vertical line until it cuts the graph. Then from this point follow the horizontal line until it cuts the vertical scale and read this amount.

4. Find the average yearly earnings of the age group 30–34.

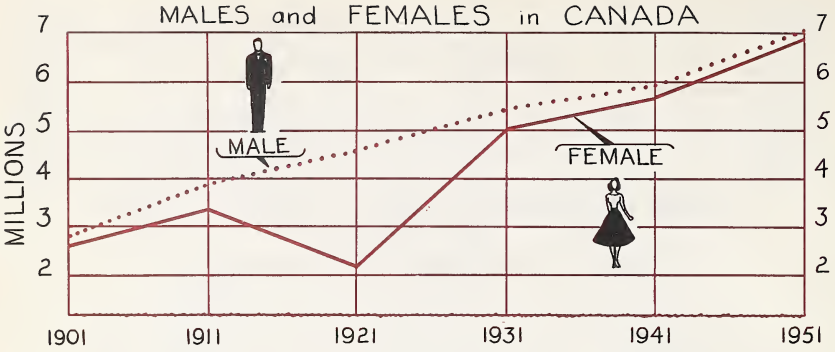
5. Approximately, what were the average yearly earnings of the age group 35–44?

> The exact amount cannot be read from the graph. The graph cuts the space of this age group about $\frac{4}{5}$ of the way between $3500 and $4000. Estimate this amount.

6. Approximately, what were the average yearly earnings of the age group 45–54? of the age group 55–65?

★7. Draw a graph to the same scale as the one above to show the following average yearly earnings of those who had no schooling beyond the fourth grade. Now compare the two graphs.

Age Group	Earnings	Age Group	Earnings	Age Group	Earnings
25–29	$1000	35–44	$1150	55–64	$1000
30–34	$1200	45–54	$1100		



The graph shows the number of males and of females in our country during the first half of this century.

1. What does the solid line represent? What does the dotted line represent?

2. The break in the graph at the bottom shows that part of the graph has been cut off. At what value does the vertical scale begin?

3. Estimate the number of females there were in this country in 1901; in 1921; in 1941; in 1951.

4. Estimate the number of males there were in this country for the years given in problem 3.

5. Estimate the total population of our country in 1901; in 1931; in 1951.

6. The number of males and females in 1926 is found by reading the graphs at the points which are midway between the points for 1921 and 1931. In 1926 the approximate number of males was 5 million. Approximately, what was the number of females in that year? About what was the total population of our country in 1925?

7. In which year was there the greatest difference between the number of males and females? Estimate the total population of our country for that year.

★8. Estimate the population of our country in 1916; in 1936; in 1946.

★9. From the graph, would you predict that there will be more or fewer males than females in 1961?

Practise What You Have Learned

1. $\begin{array}{r} .735 \\ .964 \\ \underline{.388} \end{array}$ 2. $\begin{array}{r} .074 \\ \underline{-.038} \end{array}$ 3. $\begin{array}{r} 76 \\ \underline{\times 6\frac{3}{4}} \end{array}$ 4. $\begin{array}{r} 9\frac{1}{2} \\ \underline{-1\frac{5}{6}} \end{array}$ 5. $\begin{array}{r} 3\frac{1}{2} \\ 6\frac{1}{4} \\ \underline{2\frac{7}{8}} \end{array}$

6. $\frac{7}{8}$ of 425 = 7. $\frac{3}{4} \times 1\frac{1}{2} \times 3\frac{1}{7} =$ 8. $4\frac{1}{5} \div 1\frac{3}{4} =$

9. $96 \div \frac{3}{4} =$ 10. $2 \div 3\frac{1}{2} =$ 11. $1000 \times 3.14 =$

12. To the nearest 0.01, give the value of .275, of .064.

13. Without recopying, find the sum of:

a. $378 + 956 + 28 + 304 + 47$

b. $906 + 483 + 295 + 84 + 706$

Applications of Common and Decimal Fractions

1. How many quarter inches are there in $3\frac{1}{2}$ inches?

2. How many pieces of ribbon $\frac{3}{4}$ yard long can be cut from a ribbon 10 yards long? What is the length of the piece of ribbon remaining?

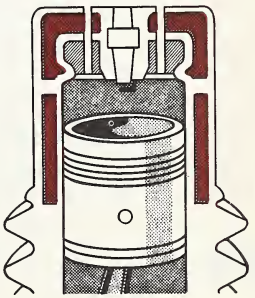
3. At 86¢ a pound, what is the cost of a ham which weighs $14\frac{3}{4}$ pounds?

4. The side of a square is 3.4 feet long. What is the perimeter of the square?

5. A farmer planted 1.25 bushels of wheat to an acre. If he planted 18.5 acres of wheat, how many bushels of wheat did he plant?

6. Show why the product of 7.38 and 6.75 must be between 42 and 56. Find the exact value of the product.

★7. The drawing on the right shows a piston of an engine. The diameter of the piston is 3.750 inches with a **tolerance** of .0004 inch. This means that the actual diameter of the piston may be .0004 inch greater or smaller than 3.750 inches. What is the greatest diameter the piston may have and be within tolerance? the smallest diameter the piston may have and be within tolerance?



Important Points in Multiplication of Decimals

A. Multiply decimals in the same way as whole numbers.

1. Find the product of 3 and .37.

$$\begin{array}{r} .37 \\ \times 3 \\ \hline 1.11 \end{array}$$

a. How many hundredths are there in the product?
b. What other process may be used to find the answer?

2. Find the product of .3 and 14.

$$\begin{array}{r} 14 \\ \times .3 \\ \hline 4.2 \end{array}$$

Use common fractions to show that the product is correct.

B. There are as many decimal places in the product as in the sum of the number of decimal places in the numbers being multiplied.

3. Find the product of .6 and 3.4.

$$\begin{array}{r} 3.4 \\ \times .6 \\ \hline 2.04 \end{array}$$

a. What is the sum of the number of decimal places in the two numbers being multiplied? How many decimal places in the product?
b. Find the approximate product and show that the answer above is sensible. Think, "3.4 is approximately 3 and .6 is .6." Then multiply 3 by .6.

4. By approximation, find the position of the decimal point in each of the following products. Then check the solution by working the example.

a. $.15 \times .24 = 360$	d. $.35 \times 1.4 = 490$	g. $.04 \times .26 = 104$
b. $.06 \times 1.5 = 90$	e. $.8 \times .765 = 6120$	h. $1.9 \times 2.1 = 399$
c. $1.1 \times .011 = 121$	f. $1.6 \times .016 = 256$	i. $1.8 \times .18 = 324$

C. To multiply a decimal by 10, 100, or 1000, move the point as many places to the right as there are zeros in the multiplier.

5. Multiply 3.14 by 1000.

$1000 \times 3.14 = 3140$

How many places was the point moved?
In which direction was it moved?

MORE PRACTICE 378

Diagnostic Test in Multiplication of Decimals

Multiply and check the following:

	a	b	c
I.	3.7	.67	.125
(367)	4	8	7
II.	46	72	568
(367)	.6	.09	3.7

	a	b	c
III.	4.8	7.36	.92
(367)	3.5	4.5	.56
IV.	.3	.54	.25
(368)	.3	.07	.25

V. Multiply each of the following by 100; by 1000.

(368) a. 7.1 b. .358 c. .065 d. 3.1416

Check your answers with those given on page 352. If you had more than one example incorrect in any group, review the Study Helps on page 62. For practice, turn to the page number given in the parentheses.

★For Those Who Made No Errors on the Above Test

Usually, students who take a course in Business Arithmetic are taught short cuts in different processes they will use. One of the shortcuts is to multiply by a two-place number without writing two partial products as we usually do when we multiply by a two-place number, such as 34.

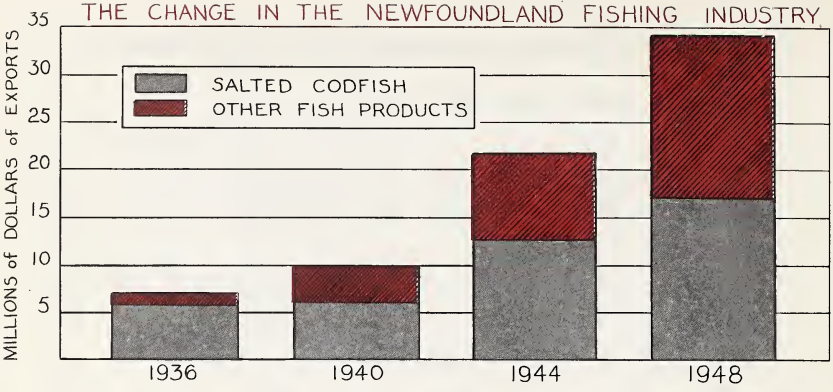
1. Multiply 56 by 34 without writing each partial product.

The thought pattern to use in the shortcut is as follows:
"4 × 6 = 24. Write 4 and carry 2."
"4 × 5 = 20; add the carried number, making 22."
Now think, "3 × 6 = 18; 18 + 22 = 40. Write 0 and carry 4."
Next think, "3 × 5 = 15; 15 + 4 = 19. Write 19."
Check the example by multiplying in the usual way.

$$\begin{array}{r} 56 \\ \times 34 \\ \hline 1904 \end{array}$$

Use the method shown to multiply in the examples below. Check by writing each partial product and adding in the usual way.

2.	3.	4.	5.	6.
53	37	42	7.8	4.9
×24	×26	×1.3	×26	×3.2



The Newfoundland Fishing Industry

The graph shows how the fishing industry in Newfoundland has changed over a period of twelve years according to export value.

1. What was the approximate value of salted codfish exported during the four separate years which are shown? Of other fish products?

2. Approximately what percentage of exports in 1936 was salted codfish? in 1948?

3. Approximately how much greater, in millions of dollars, was the export value of other fish products in 1948 than in 1944?

4. In 1947, about 22,500 inshore fishermen earned approximately $480 each. What was the total earnings of the fishermen?

5. In 1948 the value of fresh fish exports from Newfoundland was about five million dollars. What percentage of the total exports was this?

6. In 1947 the quantity of fresh frozen fillets produced was 12.5 million pounds.; in 1952 it was 36 million. How many times greater was the 1952 production than the 1947? If the 1952 production was valued at 7.5 million dollars, how much was the fillet worth a pound?

★7. Make a list of the kinds of fish caught in your province.

★8. Several provinces now have Fishery Co-operatives. What are some of the advantages of a Fishery Co-operative?

★9. What kinds of frozen fish are sold in your community?

Practise What You Have Learned

1. $\begin{array}{r} 738 \\ 96 \\ 1485 \\ 609 \\ 4356 \\ 74 \\ \hline \end{array}$

2. $\begin{array}{r} 43{,}721 \\ -42{,}958 \\ \hline \end{array}$

3. $\begin{array}{r} 807 \\ \times 608 \\ \hline \end{array}$

4. $\begin{array}{r} 78 \\ \times 6\frac{3}{4} \\ \hline \end{array}$

5. $\begin{array}{r} 7\frac{1}{2} \\ 2\frac{3}{4} \\ 9\frac{5}{6} \\ 4\frac{1}{3} \\ \hline \end{array}$

6. $\begin{array}{r} .735 \\ -.728 \\ \hline \end{array}$

7. $\begin{array}{r} .85 \\ \times 3.8 \\ \hline \end{array}$

8. $\begin{array}{r} .16 \\ \times .4 \\ \hline \end{array}$

9. $7\overline{)3129}$

10. $28\overline{)5714}$

11. $475\overline{)13726}$

12. $9\frac{3}{4} \div 2\frac{1}{2} =$

13. $3\frac{1}{2} \times 4\frac{1}{2} =$

14. $\frac{5}{6} \times 1\frac{1}{2} \times 3\frac{2}{3} =$

15. $\begin{array}{r} 4 \text{ lb. } 9 \text{ oz.} \\ 3 \text{ lb. } 12 \text{ oz.} \\ 15 \text{ oz.} \\ \hline \end{array}$

16. $\begin{array}{r} 5 \text{ ft. } 8 \text{ in.} \\ -4 \text{ ft. } 9 \text{ in.} \\ \hline \end{array}$

17. $\begin{array}{r} 3 \text{ doz. } 8 \text{ units} \\ \times 4 \\ \hline \end{array}$

Number Quickies

1. How many thousandths are there in 2.5?

2. How many hundreds are there in 1750?

3. A certain whole number rounded off to the nearest hundred is 4200. What is the greatest value the number could have had before it was rounded off? What is the least value it could have had?

4. The product of two numbers is 1296. If one of the numbers is 54, what is the other number?

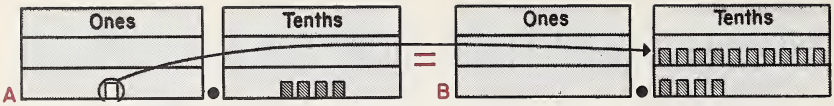
5. If $1\frac{1}{2}$ lb. of unshelled peanuts give 1 lb. of shelled nuts, how many pounds of shelled nuts will 60 lb. of unshelled peanuts make?

6. There are how many seconds in 2.4 minutes?

7. At a speed of 60 m.p.h., an object moves 88 ft. per second. How many feet will an object move at a speed of 45 m.p.h.?

8. A driver's reaction time is the time between sighting an object and the time he is able to apply the brakes on his car. If a driver's reaction time is .4 second, how many feet will his car travel during his reaction time when the speed of the car is 60 m.p.h.?

9. If oranges sell at 39¢ a dozen, what would a grocer receive for a box of 180 oranges sold at that price?



Dividing a Decimal by a Whole Number

1. What number do the cards represent in the place-value pockets in A? These cards are regrouped in B. What is shown in B?

2. Divide the cards in B into two equal groups. How many cards will there be in each group? What number do the cards in each group represent? Use the diagram to show that the solution on the right is correct.

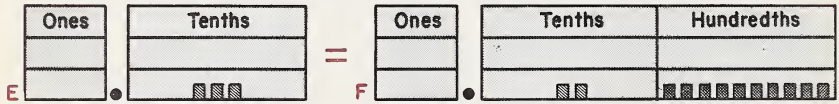
$$2\overline{)1.4}\qquad .7$$

3. Write in words the number the cards represent in the place-value pockets in C; in D.

4. Divide the cards in D into two equal groups. What number do the cards in each group represent? Use the diagram to show that the solution on the right is correct.

$$2\overline{).16}\qquad .08$$

5. What place does the zero hold in the quotient in problem 4?



6. What is shown by the cards in the place-value pockets in E; in F?

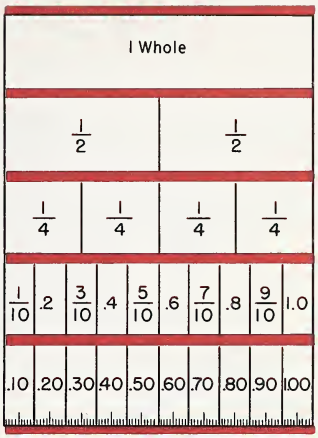
7. Divide the cards in F into two equal groups. What number do the cards in each group represent? Use the diagram to show that the solution given on the right is correct.

$$2\overline{).3} = 2\overline{).30}\qquad .15$$
$$2$$
$$10$$
$$10$$

Divide; then check by multiplying quotient and divisor.

8. $3\overline{)7.2}$
9. $8\overline{)2.8}$
10. $4\overline{)8.6}$
11. $9\overline{)6.3}$
12. $6\overline{)1.5}$
13. $12\overline{)7.5}$
14. $7\overline{).42}$
15. $15\overline{).6}$

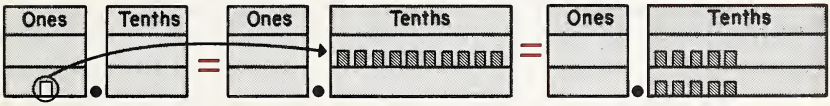
Changing Common Fractions to Decimal Fractions



1. Use the diagram to find how many tenths there are in $\frac{1}{2}$; in $\frac{1}{4}$; in $\frac{3}{4}$.

2. Use the diagram to find how many hundredths there are in $\frac{1}{2}$; in $\frac{1}{4}$; in $\frac{3}{4}$.

The diagram shows that $\frac{1}{2} = .5$. Every common fraction represents a process in division. It follows, then, that we may divide the numerator of a fraction by its denominator to find the decimal fraction equal to the common fraction. Before we can divide the numerator 1 of the fraction $\frac{1}{2}$ by 2, the 1 must be expressed as tenths, as shown in the place-value chart.



3. The 1 is changed to 10 tenths. Divide the cards representing tenths into two equal groups. What number do the cards in each group represent?

$$2\overline{)1.0}\quad .5$$

4. Find the decimal value of $\frac{3}{4}$.

$$\frac{3}{4} = 4\overline{)3} = 4\overline{)3.00}\quad .75$$

$$\begin{array}{r} 28 \\ \hline 20 \\ 20 \\ \hline \end{array}$$

Think, "3 ones cannot be divided as ones by 4, so change 3 to 30 tenths, or 3.0. Then divide by 4. There is a remainder, so annex another zero to 3.0. The 30 tenths are now changed to 300 hundredths, or 3.00. This number can be divided without a remainder.

Change the following common fractions to decimal fractions. If the exact value cannot be found, carry the work to two decimal places and write the remainder as a fraction in the quotient.

	a	b	c	d	e	f	g
5.	$\frac{3}{5}$	$\frac{1}{8}$	$\frac{1}{4}$	$\frac{5}{8}$	$\frac{2}{5}$	$\frac{2}{3}$	$\frac{3}{8}$
6.	$\frac{5}{6}$	$\frac{4}{5}$	$\frac{7}{8}$	$\frac{1}{12}$	$\frac{5}{12}$	$\frac{9}{16}$	$\frac{5}{16}$

PHOTO BY TUROFSKY

Finding Ratios in Sports

The table shows the final standing of teams in the National Hockey League in a recent year.

	Played	Won	Lost	Tied	Points
Red Wings	**70**	**44**	**13**	**13**	**101**
Maple Leafs	**70**	**41**	**16**	**13**	**95**
Canadiens	**70**	**25**	**30**	**15**	**65**
Bruins	**70**	**22**	**30**	**18**	**62**
Rangers	**70**	**20**	**29**	**21**	**61**
Black Hawks	**70**	**13**	**47**	**10**	**36**

1. The Montreal Canadiens played 70 games and won 25. The ratio of the games won to the games played is $\frac{25}{70}$.

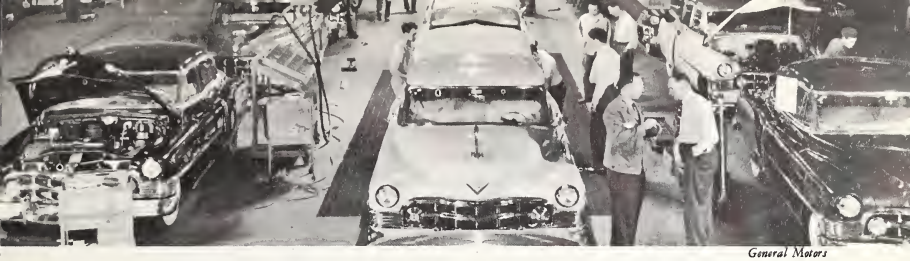
$\frac{25}{70} = .3057$ The ratio to the nearest thousandth is .306.

70)25.

2. Find to the nearest thousandth the ratio of ties by the Red Wings. Wins by the Maple Leafs. Losses by the Black Hawks.

3. Find the ratio of points to the number of games played by the Rangers; the Bruins; the Canadiens.

4. A ball player who was at bat 549 times made 177 hits. What was his batting average (the ratio of hits to times at bat to nearest thousandth)?



General Motors

Dividing a Whole Number by a Decimal

1. During a recent year an average of one new car was manufactured every 1.2 seconds. At that rate, how many new cars were manufactured in a minute?

Think: $1.2 = 1\frac{2}{10} = 1\frac{1}{5}$; $60 \div 1\frac{1}{5} = ?$

Find the answer by use of common fractions.

2. We know that $3 \times 5 = 15$, and $15 \div 3 = 5$. Likewise, $50 \times 1.2 = 60$; then $60 \div 1.2 = 50$. Explain each step in the solution.

3. We found that 50 is the quotient of $60 \div 1.2$. The quotient of $600 \div 12$ is also 50. We may change the example $1.2\overline{)60}$ so as to make the divisor a whole number by multiplying both divisor (1.2) and dividend (60) by 10. Then the example becomes $12\overline{)600}$. Solve this example.

4. By what number must .6 be multiplied to have a product of 6? 3.14 be multiplied to have a product of 314? .075 be multiplied to have a product of 75?

To divide by a decimal, change the divisor to a whole number by multiplying by 10, by 100, or by 1000, as may be necessary. Then multiply the dividend by the same number.

5. Explain the steps in each of the following examples:

a. $.6\overline{)15} = 6\overline{)150}$ (25)

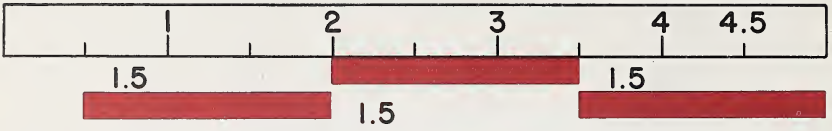
$10 \times .6 = ?$ $10 \times 15 = ?$

b. $.04\overline{)8} = 4\overline{)800}$ (200)

$100 \times .04 = ?$ $100 \times 8 = ?$

Divide and check each of the following:

6. $.4\overline{)12}$ 7. $.5\overline{)1}$ 8. $.08\overline{)28}$ 9. $.03\overline{)72}$ 10. $.06\overline{)18}$



Dividing a Decimal by a Decimal

1. How many pieces of ribbon 1.5 yards long can be cut from a ribbon 4.5 yards long? Use the diagram to find the answer.

2. Find the answer to problem 1 by use of common fractions.

3. Since $3 \times 1.5 = 4.5$, what does $4.5 \div 1.5$ equal?

4. To find $4.5 \div 1.5$, we can proceed as shown below. Explain each step in the solution. Write the division example as a fraction, or $\frac{4.5}{1.5}$.

$$\frac{4.5}{1.5} = \frac{10 \times 4.5}{10 \times 1.5} = \frac{45}{15} = 15\overline{)45}^{\,3}$$

By what number were both 4.5 and 1.5 multiplied?

To divide by a decimal, change the divisor to a whole number by multiplying by 10, by 100, or by 1000, as may be necessary. Then multiply the dividend by the same number.

5. Explain the steps in each of the following samples:

a. $.2\overline{).18} = 2\overline{)1.8}^{\,.9}$ b. $.03\overline{)7.2} = 3\overline{)720}^{\,240}$ c. $1.2\overline{).6} = 12\overline{)6} = 12\overline{)6.0}^{\,.5}$

Divide; then check by multiplying quotient and divisor.

	a	b	c	d	e
6.	$.3\overline{).12}$	$.2\overline{).14}$	$.06\overline{).9}$	$.8\overline{).28}$	$.07\overline{)2.1}$
7.	$.9\overline{).63}$	$.05\overline{).1}$	$.4\overline{)2.1}$	$.06\overline{)1.5}$	$.9\overline{).18}$
8.	$2.5\overline{).6}$	$1.5\overline{).9}$	$.16\overline{).8}$	$2.8\overline{).56}$	$.75\overline{).06}$
9.	$1.8\overline{).72}$	$.21\overline{).042}$	$1.4\overline{)9.8}$	$.25\overline{).1}$	$.16\overline{).3}$
10.	$.01\overline{).1}$	$2.4\overline{).12}$	$.48\overline{)1.2}$	$.05\overline{)4.3}$	$2.3\overline{).46}$

Four Kinds of Examples in Division of Decimals

The four kinds of examples in division of decimals are :

A. Dividing a decimal by a whole number, as $2\overline{)1.2} = .6$.

B. Dividing two whole numbers and getting a decimal in the quotient, as $5\overline{)7} = 1.4$.

C. Dividing a whole number by a decimal, as $.5\overline{)2} = 5\overline{)20} = 4$.

D. Dividing a decimal by a decimal, as $.5\overline{).2} = 5\overline{)2.0} = .4$.

The following sets of exercises for practice illustrate the four kinds of examples given in division of decimals. Solve and check.

Set A

	a	b	c	d	e
1.	$6\overline{).48}$	$8\overline{).36}$	$4\overline{).1}$	$3\overline{)8.4}$	$8\overline{)52.4}$
2.	$3\overline{).81}$	$9\overline{).72}$	$5\overline{).3}$	$24\overline{).72}$	$14\overline{)19.6}$

Set B

1.	$6\overline{)3}$	$25\overline{)4}$	$8\overline{)7}$	$20\overline{)9}$	$16\overline{)11}$
2.	$50\overline{)1}$	$28\overline{)14}$	$36\overline{)90}$	$75\overline{)6}$	$44\overline{)550}$

Set C

1.	$.3\overline{)9}$	$.4\overline{)3}$	$.5\overline{)8}$	$.06\overline{)12}$	$1.8\overline{)9}$
2.	$7.5\overline{)3}$	$2.5\overline{)5}$	$3.2\overline{)432}$	$1.6\overline{)64}$	$.36\overline{)27}$
3.	$1.5\overline{)9}$	$1.6\overline{)264}$	$2.5\overline{)2}$	$.12\overline{)15}$	$.08\overline{)1}$

Set D

1.	$.2\overline{)7.2}$	$.4\overline{).172}$	$.8\overline{)5.84}$	$.5\overline{).31}$	$.09\overline{)3.6}$
2.	$.5\overline{)107.1}$	$6.5\overline{).1625}$	$6.8\overline{).34}$	$4.5\overline{)10.35}$	$3.6\overline{)93.6}$

MORE PRACTICE

378 379

Using Your Head in Locating the Decimal Point

In the examples below, the answers are given without the decimal points. We can use approximation to find where the decimal points should be placed. Study the following three examples to be sure you understand the method used.

1. $54 \div 1.8 = 3$. (Decimal point in quotient not given.)

Think, "1.8 is approximately 2. Then $54 \div 2 = 27$. Hence, the quotient of $54 \div 1.8$ is 30 and not 3."

2. $7.25 \div 2.5 = 28$. (Decimal point in quotient not given.)

Think, "7.25 is approximately 7 and 2.5 is approximately 3. Then $7 \div 3$ is slightly more than 2. Hence, the quotient of $7.25 \div 2.5$ is 2.8 and not 28 or .28."

3. $1.35 \div .045 = 3$. (Decimal point in quotient not given.)

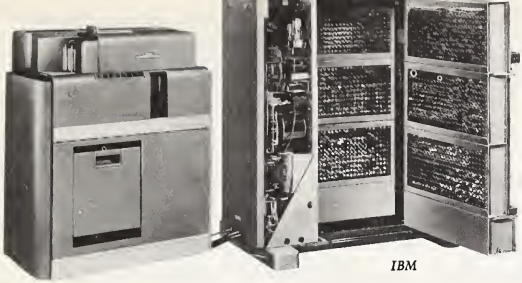
Think, "1.35 is approximately 1 and .045 is approximately .05. Then $1 \div .05$ is 20. Hence, the quotient of $.135 \div .045$ is approximately 20. The answer must be 30 and not 3."

Find the position of the decimal point in the answer to each of the following examples by using approximation and writing the correct quotient. Then check each answer by performing the process.

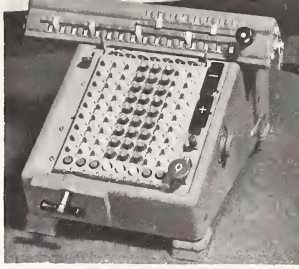
	a	b	c
4.	$1.21 \div 1.1 = 11$	$57.6 \div 2.4 = 24$	$.324 \div 1.8 = 18$
5.	$.625 \div 25 = 25$	$5.75 \div .25 = 23$	$210 \div 1.5 = 14$
6.	$1.296 \div .36 = 36$	$.144 \div .12 = 12$	$15.6 \div 1.2 = 13$
7.	$3.7 \times .43 = 1591$	$.25 \times 3.8 = 950$	$.16 \times .24 = 384$
8.	$1.9 \times .21 = 399$	$.06 \times .78 = 468$	$100 \times .025 = 2500$
9.	$.648 \div 18 = 36$	$1.024 \div 3.2 = 32$	$.75 \times 25 = 1875$
10.	$1.4 \times .28 = 392$	$.624 \div .26 = 24$	$5.5 \times .45 = 2475$

Relation Between Multiplication and Division

1. Since $20 \times 3.5 = 70$, what is the quotient of $70 \div 3.5$?
2. Since $1.5 \times 2.5 = 3.75$, what is the quotient of $3.75 \div 1.5$?
3. Since $2.24 \div 1.4 = 1.6$, what is the product of 1.4×1.6?
4. Since $32 \div .25 = 128$, what is the product of $128 \times .25$?



IBM



Monroe

★ Mechanical Brains Work Fast

The table gives the average time it takes to perform any of the arithmetical operations (addition, subtraction, multiplication, and division) and the time for a multiplication operation on each of three different laboratory calculators, A, B, and C, and on Machine D, which is an office calculator.

Machine	Average Time for All Operations	Time for a Multiplication Operation
A	.002 sec.	.0002 sec.
B	.1 sec.	.010 sec.
C	2 sec.	.25 sec.
D	10 sec.	10 sec.

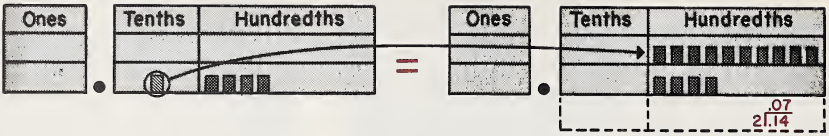
1. The average time for all operations of Machine A is how many times as much as the time for a multiplication operation? The time for a multiplication operation is what part of the average time for all operations?

2. The average time for all operations of Machine D is how many times as much as the time for Machine C? as the time for Machine B? as the time for Machine A?

3. The time for a multiplication operation for Machine D is how many times as much as the time for the same operation for Machine B? as the time for Machine A?

4. How many multiplications is Machine B able to make while Machine C makes one multiplication operation?

5. In one second, how many multiplications can Machine A make? Machine B? Machine C?



Important Points in Division of Decimals

A. We divide decimals just as we divide whole numbers.

B. When the divisor is a decimal, change the divisor to a whole number by multiplying it by 10, 100, 1000, and so on. Then multiply the dividend by the same number. See **3** and **4**.

C. To round off the quotient to a given number of decimal places, carry the work in the quotient to one more place than the number of places needed in the answer. The usual rules which govern rounding off apply to decimals. Thus, to the nearest hundredth, .234 is .23, but .235 to the nearest hundredth is .24. See **5**.

D. The number of decimal places to which a quotient should be expressed depends upon the problem. For most work, expressing the quotient to the nearest hundredth is sufficient.

1. Divide .14 by 2.

$2\overline{).14}$ Use the diagram to show that the solution is correct.

2. Divide 1 by 2.

$2\overline{)1.0}$ To divide, it was necessary to express the 1 as how many tenths?

3. Divide 8 by .4.

$.4\overline{)8} = 4\overline{)80}$ By what number were both divisor and dividend multiplied?

4. Divide .75 by 1.5.

$1.5\overline{).75} = 15\overline{)7.5}$ How can you tell by inspection that the quotient must be less than 1?

5. To the nearest 0,01, what is the value of $\frac{5}{7}$?

$\frac{5}{7} = 7\overline{)5.000}$ .714 to the nearest hundredth is .71. Work out the division to show that the quotient is correct.

Diagnostic Test in Division of Decimals

Divide. If the exact quotient cannot be found, express the quotient to the nearest hundredth.

	a	b	c	d	
I.	$3\overline{).84}$	$9\overline{)7.2}$	$5\overline{)21.5}$	$6\overline{).78}$	(368)
II.	$4\overline{).28}$	$6\overline{).33}$	$7\overline{).35}$	$8\overline{).124}$	(368)
III.	$8\overline{)5}$	$5\overline{)23}$	$12\overline{)15}$	$14\overline{)91}$	(369)
IV.	$.4\overline{)6}$	$.3\overline{)51}$	$1.6\overline{)20}$	$2.5\overline{)42}$	(369)
V.	$.4\overline{).18}$	$1.5\overline{).96}$	$.25\overline{).7}$	$.36\overline{)1.44}$	(369)
VI.	$9\overline{)7}$	$7\overline{)9}$	$15\overline{)4}$	$12\overline{)50}$	(369)

Check your answers with those given on page 352. If you had more than one example incorrect in any group, review the Study Helps on page 74. For practice, turn to the page number given in the parentheses.

★For Those Who Made No Errors on the Above Test

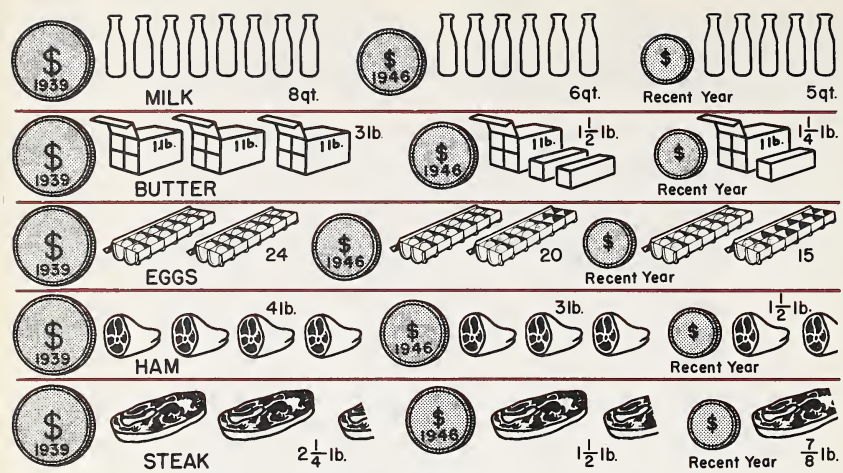
The exact value of certain fractions cannot be expressed decimally. Thus, $\frac{1}{3} = .3333\ldots$ A decimal such as .333... is called a **repeating decimal** because the numbers repeat in a certain order.

1. Write the value of each of the fractions $\frac{1}{9}$, $\frac{2}{9}$, $\frac{3}{9}$, $\frac{4}{9}$, $\frac{5}{9}$, $\frac{6}{9}$, $\frac{7}{9}$, and $\frac{8}{9}$, correct to three decimal places.

2. Use division to find the value of $\frac{1}{11}$ and $\frac{2}{11}$ to four decimal places. Then, by inspection, write to four decimal places the value of the other proper fractions which have 11 as the denominator.

3. The value of the fraction $\frac{1}{7}$ to six decimal places is .142857 and then the numbers repeat. Change $\frac{2}{7}$ to a decimal. Carry the quotient to eight places. Do the figures begin to repeat?

4. Find the decimal values of $\frac{3}{7}$, $\frac{4}{7}$, $\frac{5}{7}$, and $\frac{6}{7}$ to six places. At what point could you predict what the next number would be, just from studying the digits of the previous decimal fractions?



The Shrinking Value of the Dollar

The graph shows the amounts of certain foods which could be purchased with a dollar in a large city of the U. S. A., in three different years.

1. From the graph, find the number of pounds of butter that could be purchased with a dollar in 1939; in 1946; in a recent year.

2. To the nearest cent, what was the cost of a pound of butter in each year given in problem 1?

3. From the graph, find the number of pounds of steak that could be purchased with a dollar in 1939; in 1946; in a recent year.

4. To the nearest cent, what was the cost of a pound of steak in each year given in problem 3?

5. To the nearest cent, find the cost of a pound of ham in 1939; in 1946; in a recent year.

6. To the nearest cent, find the cost of a quart of milk in 1939; in 1946; in a recent year.

7. What was the cost of a dozen eggs in 1939? in 1946? in a recent year?

★8. What is meant by the purchasing power of the dollar? Use the illustration to show how the purchasing power changes.

Applications of Decimals

1. How many thousands are there in 1.2 million?
Hint: First write 1.2 million with figures.

2. There are 47 quarts in 100 pounds of milk. To the nearest tenth of a pound, what is the weight of a quart of milk?

3. A farmer raised an average of 17.84 tons of tomatoes an acre. How many tons did he raise on 8.5 acres?

4. A safety razor blade is .004 inch thick. At that rate, how many blades are needed to make a thickness of .1 in.? a thickness of 1 in.?

5. A team won 18 games and lost 13 games. Express its "percentage" of wins as a three-place decimal.

6. In baseball, a "300 hitter" means that a batter averages at least 3 hits in 10 times at bat. Which of the following is a "300 hitter"?

a. Tom—12 (H) in 32 (AB) b. Ross—15 (H) in 48 (AB)
c. Joe—61 (H) in 250 (AB)

★7. In the American League, Hoot Evers set a new fielding record in baseball. His record was .9970 and the former record held by Joe Di Maggio was .9968. Who had the better record? How much better? Has this record been bettered since that time?

Practise What You Have Learned

1. $\begin{array}{r} .748 \\ .356 \\ .905 \\ \underline{.286} \end{array}$

2. $\begin{array}{r} 41{,}305 \\ \underline{-21{,}608} \end{array}$

3. $\begin{array}{r} 7\frac{1}{3} \\ \underline{-2\frac{5}{6}} \end{array}$

4. $\begin{array}{r} 907 \\ \underline{\times 408} \end{array}$

5. $\begin{array}{r} 3\frac{1}{2} \\ 2\frac{5}{6} \\ 7\frac{3}{4} \\ \underline{5\frac{1}{3}} \end{array}$

6. $28\overline{)85476}$

7. $375\overline{)124563}$

8. $\begin{array}{r} 7.51 \\ \underline{-3.48} \end{array}$

9. $8\frac{1}{2} \times 3\frac{1}{4} =$

10. $\frac{5}{6} \div 1\frac{2}{3} =$

11. $1.2 \div .03 =$

12. $2.8 \times 3.9 =$

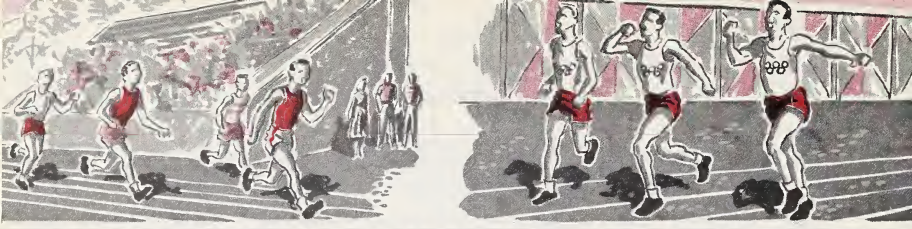
13. $7.4 \div 100 =$

14. $2\frac{1}{3} \times 5\frac{2}{5} \times 1\frac{1}{2} =$

15. Add: 7 ft. 9 in., 4 ft. 10 in., 3 ft. 11 in., 5 ft.

16. Multiply 4 lb. 9 oz. by 2; by 3.

17. Express $\frac{9}{16}$ as a decimal to the nearest hundredth.



The Metric System of Measurement

The pictures above show runners in a 100-yard race at a school track meet and runners in a 100-meter race at the Olympics.

The yard is a unit of length in our system of measurement. The **meter** in the metric system is the unit of measure used in most other countries except in England and the United States.

1. A meter is equal to 39.37 inches. A meter is how much longer than a yard?
2. Prove that a meter is equal to approximately 1.1 yards.
3. How many inches are there in 100 yards? in 100 meters?

The table of metric measures of length is given below.

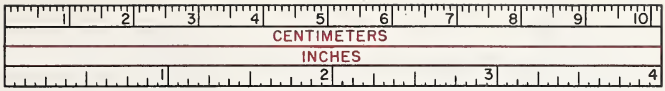
10 millimeters (mm.)	=	1 centimeter (cm.)
10 centimeters	=	1 decimeter
10 decimeters	=	1 meter (m.)
10 meters	=	1 decameter
10 decameters	=	1 hectometer
10 hectometers	=	1 kilometer (km.)

The units of measure underlined are the most important units in the metric system.

4. How many millimeters are there in a meter?
5. How many centimeters are there in a meter?
6. How many meters are there in a kilometer?
7. One millimeter is what part of a meter? (**milli** = .001)
8. One centimeter is what part of a meter? (**centi** = .01)
9. A kilometer is how many times a meter? (**kilo** = 1000)
10. Find the missing numbers in the following:

a. 6 m. = ? cm.
b. 75 cm. = ? mm.
c. 7.5 km. = ? m.
d. 3440 m. = ? km.
e. 36 mm. = ? cm.
f. 1.82 km. = ? m.

MORE PRACTICE

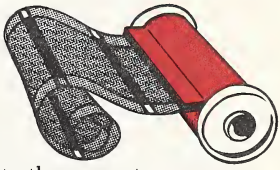


Approximate Equivalents of Certain Metric Measures

1. Approximately, how many centimeters are there in an inch?

2. If there are approximately 2.5 centimeters in 1 inch, show that 1 centimeter is equal to about .4 inch.

3. If there are approximately 2.5 centimeters in an inch, about how many millimeters are there in an inch?



4. Dick has a camera which uses 35 millimeter film. This means that the film is 35 millimeters wide. How many centimeters wide is the film?

5. Select the answer below which is nearest to the correct answer. Check your answer.

a. The width of a 35-millimeter film is approximately: $2\frac{1}{2}$ in., 2 in., $1\frac{1}{2}$ in., 1 in.

b. The width of a 15-millimeter film is approximately: $1\frac{1}{2}$ in., $\frac{1}{2}$ in., 1 in., $\frac{1}{4}$ in.

6. The approximate equivalents of certain metric measures are:

1 centimeter = .4 in.
1 meter = 1.1 yd. or 3.3 ft.
1 kilometer = $\frac{5}{8}$ mi.

If you are 5 ft. 6 in. tall, approximately, what is your height in centimeters?

7. A speed of 80 kilometers per hour is approximately equal to what speed in miles per hour?

8. Find the approximate equivalents of each of the following speeds as indicated:

a. 40 m.p.h. = ? km.p.h.
b. 60 m.p.h. = ? km.p.h.
c. 120 km.p.h. = ? m.p.h.
d. 720 km.p.h. = ? m.p.h.
e. 240 m.p.h. = ? km.p.h.
f. 90 m.p.h. = ? km.p.h.

★**9.** Express in kilometers an hour the speed limit for driving on the highways of your state.

Ewing Galloway

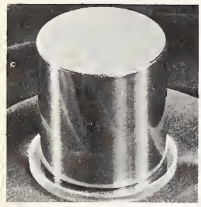
Using Metric Measures

1. The record ski jump on this continent is 307 feet. If a meter is approximately equal to 3.3 feet, about what was the length of the record jump in meters?

2. Ski jumps in Canada and the United States are designed for a jump which ranges from 60 meters to 80 meters. Approximately, what is the range in feet of the length of the ski jump?

3. Approximately, how many yards long is a 100-meter race?

4. The world's record time for the 100-meter race is 10.2 seconds. To the nearest meter, what was the average number of meters per second run in this race?



Nat. Bur. Standards

The standard metric measure for weight is the **kilogram.** A kilogram weighs approximately 2.2 pounds.

5. There are 1000 **grams** in a kilogram. If a kilogram weighs approximately 2.2 pounds, about what is the weight of a gram in pounds?

6. Rosa, a Mexican girl, gave her weight as 55 kilograms. Approximately, what was her weight in pounds?

7. A metric ton is equal to 1000 kilograms. Approximately, what is the weight of a metric ton in pounds?

8. A metric ton weighs approximately how much more than our ton?

9. How many metric tons are there in 7500 kilograms? in 950 kilograms? in 10,250 kilograms?

★10. Why is it easier to change from one unit to another unit in the metric system of weights and measures than it is in our system of weights and measures?

Getting Ready for Progress Test in the Fundamentals

I. Add:

1.	2.	3.	4.	5.
476	.735	$7\frac{1}{2}$	$9\frac{3}{4}$	$17\frac{1}{2}$
2988	.568	$2\frac{1}{3}$	8	$14\frac{3}{8}$
57	.092	$6\frac{3}{4}$	$7\frac{5}{6}$	15
605	.450	$4\frac{2}{3}$	$2\frac{1}{2}$	$12\frac{3}{4}$
4394	.326			

6. Add 5 min. 28 sec., 4 min. 35 sec., and 14 min. 27 sec.

II. Subtract:

1.	2.	3.	4.	5.
3142	7219	30,405	9001	10,243
3085	4536	2,739	3056	9,467

6.	7.	8.	9.	10.
8	$9\frac{1}{2}$	$14\frac{1}{3}$	$10\frac{1}{4}$	$17\frac{1}{3}$
$5\frac{2}{3}$	$2\frac{7}{8}$	$8\frac{5}{6}$	$9\frac{7}{8}$	$8\frac{3}{4}$

11.	12.	13.	14.	15.
.73	.925	.025	4 ft. 6 in.	3 hr.
.48	.156	.017	3 ft. 9 in.	1 hr. 18 min.

III. Multiply:

1.	2.	3.	4.	5.
436	856	72	804	710
7	9	56	39	180

6.	7.	8.	9.	10.
3.5	.24	.16	35	38
.8	1.8	.5	.14	$8\frac{3}{4}$

11. $5\frac{1}{2}\times3\frac{1}{4}=$ 12. $4\times5\frac{2}{3}=$ 13. $5\frac{1}{4}\times3\frac{1}{7}=$ 14. $2\frac{2}{3}\times8\times1\frac{1}{4}=$

IV. Divide:

1. $8\overline{)3124}$ 2. $27\overline{)4103}$ 3. $16\overline{)8152}$ 4. $430\overline{)125473}$
5. $6\div\frac{3}{4}=$ 6. $1\frac{1}{2}\div2\frac{3}{4}=$ 7. $4\frac{1}{3}\div1\frac{2}{3}=$ 8. $\frac{2}{3}\div6=$
9. $.6\overline{)15}$ 10. $1.5\overline{)1.2}$ 11. $16\overline{)90}$ 12. $.25\overline{).7}$

How Well Do You Remember?

1. What is the value of the figure 2 in a number when it is written 4 places to the left of ones' place?

2. What is the value of the figure 2 in a number when it is written 3 places to the right of ones' place?

3. The value of the 3 in 473 is what fractional part of the value of the 3 in 374?

4. Write the number of hundreds there are in 4700; in 4750; in 47,550.

5. A three-place decimal fraction was rounded off to the nearest hundredth. If the value of the rounded off number was .47, what was the greatest value this number could have had before it was rounded off? What was the least value this number could have had?

6. In the picture on the left, the small hand on the dial points to thousands of feet. What is the altitude registered on the altimeter?

7. Find the product of 3.7 and .925. Show by approximation that your answer is sensible.

8. The number of inches of rainfall during three months in Metropolis, was 3.25 in., 2.86 in., and 4.13 in. What was the average number of inches of rainfall for the three months?

9. To the nearest hundredth, what is the value of $\frac{7}{8}$?

10. A big-league pitcher won 18 games and lost 12 games in one season. Express his pitching record as a three-place decimal.

11. Find the missing numbers in each of the following. (If necessary, refer to tables on pages 78–79.)

a. 75 mm. = ? cm. b. 465 cm. = ? m. c. 7280 m. = ? km.

12. How many kilograms are there in 3250 grams?

13. How many grams are there in 2.75 kilograms?

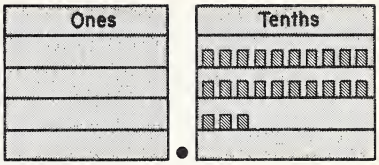
14. How many kilograms are there in 2.75 metric tons?

15. How many metric tons are there in 9780 kilograms?

16. A kilometer is approximately what fractional part of a mile?

Chapter Test

1. What number is shown in the place-value chart on the right?



2. If the cards in the chart are regrouped so as to form the greatest number of ones, what number will be formed?

3. Write the number of hundredths there are in 2; in 1.8; in .025.

4. The value of a 3, two places to the right of ones' place, is what fractional part of the value of the 3 in 30?

5. Write 2.75 millions with figures.

6. How many thousands are there in 1.5 millions?

7. To the nearest thousandth, what is the value of .0475?

8. A two-place decimal rounded off to the nearest 0.1 is .6. What is the least value this decimal could have had before it was rounded off? What is the greatest value it could have had?

9. Find the answer to each of the following:

a. $\begin{array}{r} .525 \\ -.517 \\ \hline \end{array}$ b. $\begin{array}{r} .36 \\ \times .12 \\ \hline \end{array}$ c. $.4\overline{)5}$ d. $1.6\overline{).08}$ e. $25\overline{)92}$

10. If the time for a calculating machine to perform an operation is .004 second, how many operations can it perform in a second?

11. If, on the average, a new car is manufactured every 1.5 seconds, how many new cars are manufactured in an hour?

12. A basketball player made 24 baskets in 75 tosses at the basket. Express as a three-place decimal the percentage of baskets made.

13. How many centimeters are there in 75 mm.? How many centimeters in 3.8 m.? How many centimeters in .95 m.?

14. A speed limit of 50 m.p.h. is equal to approximately how many kilometers an hour?

15. How many kilograms are there in 3.4 metric tons?

16. About how many pounds are there in 100 kilograms?

Progress Test in the Fundamentals

Solve the following examples:

1. (8) 97 / 308 / 536 / 2748 / 59

2. (8) .94 / .58 / .06 / .75

3. (8) 37,120 − 28,934

4. (11) 708 × 508

5. (29) $67 \times 7\frac{2}{3}$

6. (16) $27\overline{)1425}$

7. (16) $381\overline{)74536}$

8. (29) $2\frac{1}{2} \times \frac{3}{8} =$

9. (34) $16\frac{3}{4} \div 4 =$

10. (29) $6\frac{1}{2} \times \frac{3}{4} \times 1\frac{2}{3} =$

11. (57) $1000 \times 7.38 =$

12. (57) $5.6 \div 100 =$

13. (69) $16 \div 2.5 =$

14. (25) $5\frac{1}{2} - 3\frac{7}{8}$

15. (25) $16\frac{3}{4} - 9\frac{5}{6}$

16. (34) $2\frac{1}{4} \div 1\frac{1}{3} =$

17. (71) $20\overline{)11}$

18. (28) 5 min. 4 sec. − 2 min. 38 sec.

19. (38) 9 ft. 8 in. × 3

20. (38) $4\overline{)3 \text{ yd. } 24 \text{ in.}}$

If you did not understand how to solve an example, turn for help to the page, given in parentheses, where the step was explained.

★For Those Who Made No Errors on the Progress Test

1. Look up the metric system in an encyclopedia or some other reference book and write a brief report on its history.

2. What are the duties of the Standards Division of the Canadian Department of Trade and Commerce?

3. Find out why our number system is called the **Hindu-Arabic** number system. One of the chief characteristics of this number system is **place value.** Show what this means. How does our number system differ from the Roman number system?

4. Find examples of uses of decimals in newspapers or magazines and bring them to class. In how many of these uses was the decimal expressed to more than three places?

5. In which year were the last Olympics held? In which country?

Test in Problem Solving

Solve the following problems. If you are unable to solve a problem, turn to the page indicated on the right of the problem.

1. How many millions are there in a trillion? Write a trillion with figures. (2)

2. Round off $2\frac{3}{4}$ inches to the nearest half inch. (5)

3. How many towels $\frac{3}{4}$ yard long can be cut from a piece of cloth $4\frac{1}{2}$ yards long? (34)

4. When there are 251 members present in the House of Commons, how many are needed for a majority? (32)

5. The reservoir of a city has a capacity of 2.5 billion gallons. If the average daily consumption of water in the city is 20 million gallons, how many days' supply will the reservoir hold when filled? (24)

6. In a city election only .6 of the voters who had registered voted. If there were 7320 registered voters, how many votes were cast in the election? (54)

7. A bottle of soft drink contains 10 fluid ounces. How many bottles can be filled with 3 gallons? (38)

8. In a recent year, the death rate in this country was 9.6 per 1000 population. At that rate, how many deaths were there in a year in a population of one million? (57)

9. If the cost of a gallon of gasoline is 39¢, how many gallons, to the nearest tenth of a gallon, can be purchased with a dollar? (67)

10. An inch is approximately equal to 2.5 centimeters. There are about how many centimeters in a foot? (69)

Per Cent of Houses with Electricity Having Certain Electrical Appliances

IRONS

REFRIGERATORS

VACUUMS

MIXERS

RANGES

OIL BURNERS

Each represents 10%

FREEZERS

DISHWASHERS

CHAPTER III

Electrical Equipment in the Home

The graph on page 86 shows the per cent of homes, wired for electricity, which are equipped with certain household electrical appliances.

1. What per cent of the total number of wired homes does each symbol on the graph represent? What common fraction is equal to this per cent?

2. How many per cent represent the whole of anything?

3. In one province, only 1% of the homes wired for electricity are equipped with dishwashers. What per cent of the homes wired for electricity do not have such equipment?

4. From the graph, find approximately what per cent of the homes wired for electricity are equipped with electric irons; with electric refrigerators; with electric vacuum cleaners.

5. Approximately, what per cent of the homes wired for electricity do not have electric mixers? electric ranges? oil burners?

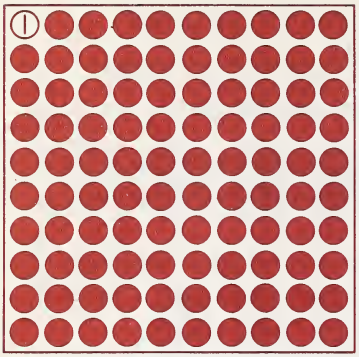
6. If one symbol represents 10% of a thing, how many symbols are needed to represent 50% of it? 25% of it? 75% of it? 100% of it?

7. Of the group of electrical appliances shown, which are in fewer than half of the homes wired for electricity?

8. Which of the appliances shown is in use in one-fourth of the homes having electric current?

9. How many of the appliances are used in more than three-fourths of the homes which are equipped with electricity? in fewer than one-fourth of the homes?

★10. How can you tell from the graph that some homes must be equipped with more than one of the electrical appliances shown?



The Meaning of Per Cent

Use a Hundred Board, as illustated on the left, to show the meaning of per cent. If you do not have a board of this kind in your classroom, have a member of your class place 100 disks or chips on a table in 10 rows of 10 disks each.

If a student picks up one of the disks, he can express the number of disks he picked up as follows:

a. 1 out of 100 disks
b. $\frac{1}{100}$ of the 100 disks
c. .01 of the 100 disks
d. 1 per cent of the 100 disks

One per cent (1%) means 1 out of 100, or it means one hundredth ($\frac{1}{100}$), or .01.

1. State how many disks on the 100-board are needed to show 5%; 12%; 75%; 83%; 100%.

2. Carol picked up 3 of the 100 disks. What three different ways may be used to represent the number of disks she picked up?

3. State each of the following in three other ways:

a. 10 out of 100 disks
b. 15% of the 100 disks
c. $\frac{1}{2}$ of the 100 disks
d. .07 of the 100 disks

Use a 100-board or draw 100 circles to find the missing numbers:

4. 2% of 100 = ?
5. 5% of 100 = ?
6. 25% of 100 = ?
7. 60% of 100 = ?
8. 75% of 100 = ?
9. $\frac{3}{100}$ = ?%
10. $\frac{1}{2}$ = ?%
11. $\frac{1}{4}$ = ?%
12. $\frac{1}{10}$ = ?%
13. $\frac{3}{4}$ = ?%
14. 6 out of 100 = ?%
15. 15 out of 100 = ?%
16. 40 out of 100 = ?%
17. 60 out of 100 = ?%
18. 75 out of 100 = ?%

19. Dick had another 100-board, giving him 200 disks in all. How many disks do 4% of the total number represent?

Think: "4% of 100 = 4, so 4% of 200 = 4 × 2 or 8."

20. Find 5% of 200; 6% of 200; 8% of 200.

Expressing Per Cents as Hundredths

We learned that per cent is another way of saying hundredths. Thus, 3% means 3 out of 100 which may be written as $\frac{3}{100}$, or as .03.

Express the following per cents as hundredths:

	a	b	c	d	e	f
1.	16%	27%	9%	40%	31%	2%
2.	50%	44%	38%	1%	90%	67%

3. When a per cent is expressed as hundredths, the per cent sign is dropped. Then how is the number written so that its value is not changed?

A per cent is not always a whole number of per cents. Thus, $3\frac{1}{2}\%$ is between 3% and 4%. The fractional part of $3\frac{1}{2}$ per cent may also be expressed as a decimal fraction, as 3.5%.

4. Explain each step illustrated in changing a per cent to a decimal fraction in the following:

a. $3.5\% = \frac{3.5}{100} = \frac{10 \times 3.5}{10 \times 100} = \frac{35}{1000} = .035$

b. $2\frac{1}{2}\% = 2.5\% = \frac{2.5}{100} = \frac{10 \times 2.5}{10 \times 100} = \frac{25}{1000} = .025$

c. $1.25\% = \frac{1.25}{100} = \frac{100 \times 1.25}{100 \times 100} = \frac{125}{10,000} = .0125$

d. $2\frac{1}{4}\% = 2.25\% = \frac{2.25}{100} = \frac{100 \times 2.25}{100 \times 100} = \frac{225}{10,000} = .0225$

Express the following as decimal fractions:

	a	b	c	d	e
5.	1.5%	12.4%	25.5%	2.6%	90.4%
6.	$1\frac{1}{2}\%$	$3\frac{1}{2}\%$	$4\frac{1}{2}\%$	$12\frac{1}{2}\%$	$37\frac{1}{2}\%$
7.	$67\frac{1}{2}\%$	$5\frac{1}{2}\%$	$1\frac{2}{5}\%$	$3\frac{7}{10}\%$	$87\frac{1}{2}\%$
★8.	$1\frac{1}{4}\%$	$2\frac{3}{4}\%$	$3\frac{1}{4}\%$	$5\frac{3}{4}\%$	$8\frac{1}{4}\%$

9. In the following, express each per cent as a decimal and each decimal as a per cent.

a. 58%	b. .285	c. 90.6%	d. 2%
e. .18	f. 3.7%	g. $62\frac{1}{2}\%$	h. $4\frac{1}{2}\%$

Changing Decimal Fractions to Per Cents

Since 3% = .03, then .03 = 3%. **Per cent means hundredths.**

1. Use the examples to explain how to change a decimal to a per cent.

a. .04 = 4% b. .2 = .20 = 20% c. .035 = 3.5%

Express the following decimal fractions as per cents:

	a	b	c	d	e	f
2.	.15	.75	.42	.36	.91	.65
3.	.02	.08	.1	.5	.4	.9
4.	.015	.075	.324	.115	.258	.026

Expressing a Common Fraction as a Per Cent

1. Express as per cents: a. $\frac{2}{5}$ b. $\frac{3}{8}$

a. $\frac{2}{5} = 5\overline{)2.0}$ (.4) .4 = .40 = 40%

b. $\frac{3}{8} = 8\overline{)3.00}$ ($.37\frac{1}{2}$) $.37\frac{1}{2} = 37\frac{1}{2}\%$ or 37.5%

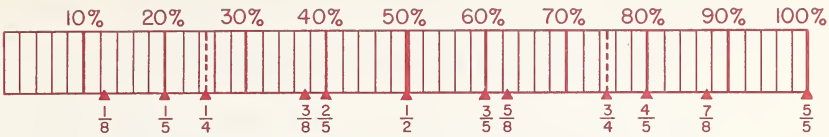
To change a common fraction to a per cent, express the fraction as hundredths and then as a per cent.

Change the following fractions to per cents:

	a	b	c	d	e	f
2.	$\frac{3}{4}$	$\frac{1}{2}$	$\frac{3}{5}$	$\frac{1}{8}$	$\frac{11}{20}$	$\frac{7}{10}$
3.	$\frac{7}{8}$	$\frac{1}{20}$	$\frac{9}{20}$	$\frac{9}{25}$	$\frac{7}{50}$	$\frac{4}{5}$
4.	$\frac{11}{50}$	$\frac{5}{12}$	$\frac{2}{3}$	$\frac{1}{6}$	$\frac{5}{6}$	$\frac{1}{12}$

You should memorize the per cent equivalents of the following:

$\frac{1}{2} = 50\%$	$\frac{1}{3} = 33\frac{1}{3}\%$	$\frac{3}{8} = 37\frac{1}{2}\%$
$\frac{1}{4} = 25\%$	$\frac{2}{3} = 66\frac{2}{3}\%$	$\frac{5}{8} = 62\frac{1}{2}\%$
$\frac{3}{4} = 75\%$	$\frac{1}{8} = 12\frac{1}{2}\%$	$\frac{7}{8} = 87\frac{1}{2}\%$



Expressing a Per Cent as a Common Fraction

The above scale shows the equivalents of certain fractions and per cents.

1. What per cent does the whole line or graph represent?

2. Each part of the graph which represents 10% is divided into how many equal parts? Each of these small parts represents what per cent of the whole graph?

3. From the graph, read the per cent equivalents of:

a. $\frac{1}{2}$ b. $\frac{1}{4}$ c. $\frac{3}{4}$ d. $\frac{1}{5}$ e. $\frac{4}{5}$ f. $\frac{5}{5}$

4. The graph shows that $\frac{1}{8}$ is approximately equal to 12%. What is the exact value of $\frac{1}{8}$ expressed as a per cent?

5. Give the approximate value and the exact value in per cent of $\frac{3}{8}$; of $\frac{5}{8}$; of $\frac{7}{8}$.

6. Find the common fraction equal to: a. 75% b. 20% c. $12\frac{1}{2}\%$

a. $75\% = \frac{75}{100} = \frac{3}{4}$ b. $20\% = \frac{20}{100} = \frac{1}{5}$

c. $12\frac{1}{2}\% = \frac{12\frac{1}{2}}{100} = \frac{2 \times 12\frac{1}{2}}{2 \times 100} = \frac{25}{200} = \frac{1}{8}$

In c multiply both numerator and denominator by 2, which is the denominator of the given fraction.

7. Change $33\frac{1}{3}\%$ to a common fraction.

$$33\tfrac{1}{3}\% = \frac{33\frac{1}{3}}{100} = \frac{3 \times 33\frac{1}{3}}{3 \times 100} = \frac{100}{300} = \frac{1}{3}$$

Multiply both numerator and denominator by 3, which is the denominator of the given fraction.

Change the following to fractions expressed in lowest terms:

	a	b	c	d	e
8.	25%	40%	15%	60%	80%
9.	$37\frac{1}{2}\%$	$66\frac{2}{3}\%$	16%	$62\frac{1}{2}\%$	70%
★10.	$6\frac{1}{4}\%$	$16\frac{2}{3}\%$	$83\frac{1}{3}\%$	$56\frac{1}{4}\%$	$2\frac{1}{2}\%$

Finding a Per Cent of a Number

1. The Carter family spends 25% of its income for food. If the yearly income is $3750, how much does this family spend for food in a year?

Method I		Method II
25% = .25	$3750 ×.25	25% = $\frac{1}{4}$
25% of $3750 =	18750 7500	$\frac{1}{4}$ of $3750 =
.25 × $3750	$937.50	$\frac{1}{4}$ × $3750 = $937.50

The Carters spend $937.50 a year for food.

To find a per cent of a number, express the per cent as a decimal fraction or as a common fraction and then multiply.

2. Find 2.6% of $680. Work this example by Method I and then by Method II.

Express 2.6% as a decimal fraction, .026.

Now multiply $680 by .026 or by $\frac{26}{1000}$.

Which method do you like better? Why?

3. Martha solved problem 2 and got an answer of $176.80. Show by approximation that this answer is not sensible.

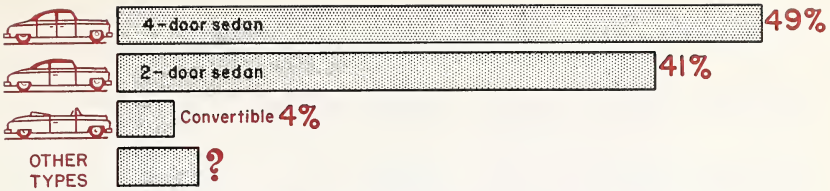
Think: "2.6% is equal to approximately 3% and $680 is about $700. 3% of $700 = $21. So 2.6% of $680 must be less than $21."

Find the answers to examples 4, 5, 6, 7, and 8 without paper and pencil. Work the others on paper.

4. 10% of 80 =	9. 6% of 75 =	14. 15% of 140 =
5. 25% of 200 =	10. 13% of 210 =	15. 48% of 760 =
6. 50% of 68 =	11. 2.9% of 870 =	16. $1\frac{1}{2}$% of 420 =
7. 100% of 17 =	12. 12.5% of 250 =	17. $2\frac{1}{2}$% of 375 =
8. $33\frac{1}{3}$% of 120 =	13. 37.5% of 160 =	18. 4.7% of 84 =

★19. Use the method given in problem 3 to show that your answers to examples 14, 15, 16, 17, and 18 are sensible.

MORE PRACTICE



Applications of Per Cent

1. A company which manufactures cars produces its styles of bodies as shown above. What per cent of cars have other types of bodies?

2. From the data in the graph, find how many cars, out of each 100,000 manufactured, are four-door sedans? How many are two-door sedans? How many are convertibles? How many are other models?

3. The enrollment in all grades of the Queen Elizabeth School is 350. If the number of boys is 48% of the enrollment, how many boys are enrolled? How many girls?

4. In problem 3, the number of girls is what per cent of the number of students enrolled?

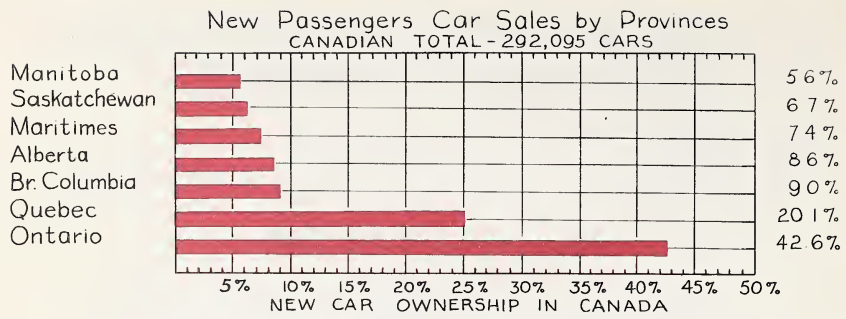
5. In one of its games, a basketball team was successful in 25% of the shots at the basket. If the players attempted 92 shots at the basket, how many of these shots were successful?

6. In a recent World's Series, the two baseball teams divided $306,160 between them. The winning team received 60% and the losing team 40%. How much did each team receive?

7. On a recent World's Series team, each player's share was 2.8% of the team's share. If his team's share was $183,700, how much did each player receive?

★8. By approximation, select the answer given that is nearest to the correct answer in each of the following. Then work the example to prove that your selection was correct.

a. 24% of 760: 160, 180, 200, 300
b. 39% of 420: 125, 200, 180, 160
c. 62% of 348: 200, 250, 150, 180
d. 18% of 1210: 275, 200, 135, 175



New Car Ownership in Canada

The graph shows the percentage, according to provinces, of new cars purchased in this country in a recent year.

1. Approximately what fractional part of all new cars were purchased in Manitoba?

2. How many new cars were purchased in the Maritimes? in Quebec? in Ontario?

3. What per cent of new cars were purchased in the rest of Canada.

4. In a recent year the total value of new cars purchased in Canada was $725,167,630. Assuming the graph represents a percentage of cost, how much was spent in the four western provinces?

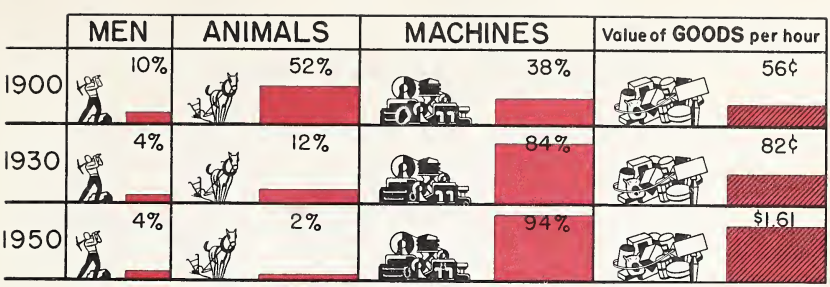
5. From problem 4, how much was spent in the rest of Canada?

6. Using the 1951 Canadian census figures, find the approximate number of persons per passenger car in Ontario.

Practise with Per Cent

Find the answers to each of the following:

	a	b	c
1.	20% of 48 =	75% of 96 =	50% of 160 =
2.	$33\frac{1}{3}$% of 69 =	$66\frac{2}{3}$% of 120 =	40% of 172 =
3.	$37\frac{1}{2}$% of 240 =	$12\frac{1}{2}$% of 320 =	$62\frac{1}{2}$% of 400 =
4.	1.5% of 470 =	2.6% of 310 =	7.4% of 135 =
5.	$2\frac{1}{2}$% of 540 =	$87\frac{1}{2}$% of 140 =	2.9% of 1200 =
6.	4.5% of 380 =	$3\frac{1}{2}$% of 1450 =	2.25% of 1600 =



The Machine Age

The picture shows the sources of power for producing goods during the first half of the century.

1. What are the three sources of power shown? Which of these sources provided the greatest percentage of power in 1900? in 1950?

2. In which of the sources of power was there the greatest percentage decrease from 1900 to 1950?

3. The per cent of power supplied by animals in 1900 was how many times as great as the per cent of power supplied by animals in 1950?

4. In 1950, the per cent of power supplied by machines was how many times as great as the per cent of power supplied by men?

5. Read the value of the goods produced per hour in 1900; in 1930; in 1950.

6. What was the value of goods produced in a 40-hour week in 1950?

7. To the nearest whole number, how many hours were needed to produce goods in 1930 equal in value to the goods produced in a 40-hour week in 1950?

8. To the nearest whole number, how many hours were needed to produce goods in 1900 equal in value to the goods produced in a 40-hour week in 1950?

9. If a company employed, on the average, 150 men, what was the value of the goods it produced in an hour in 1900? in 1950?

★10. Why is it possible for a worker to have a shorter work week and yet produce more goods than it was possible for him to produce 50 years ago?

Practise What You Have Learned

1. $\begin{array}{r} .78 \\ .54 \\ .90 \\ .55 \\ \underline{.67} \end{array}$

2. $\begin{array}{r} 10{,}324 \\ \underline{-9{,}568} \end{array}$

3. $\begin{array}{r} 875 \\ \underline{\times 68} \end{array}$

4. $\begin{array}{r} 78 \\ \underline{\times 7\frac{3}{4}} \end{array}$

5. $\begin{array}{r} 2\frac{1}{2} \\ 5\frac{1}{3} \\ 9\frac{5}{6} \\ \underline{7\frac{3}{4}} \end{array}$

6. $47\overline{)21538}$

7. $1.5\overline{)12}$

8. $\begin{array}{r} 7\frac{1}{2} \\ \underline{-6\frac{7}{8}} \end{array}$

9. $2\frac{1}{4} \times \frac{5}{6} =$

10. $\frac{7}{8} \times 2\frac{1}{3} \times 4\frac{1}{2} =$

11. $2\frac{1}{2} \div 3\frac{1}{4} =$

12. $9 \div \frac{3}{8} =$

13. $.5\overline{).37}$

14. $8\overline{)5}$

15. $1000 \times 3.14 =$

16. 4% of $325 =$

17. $2\frac{1}{2}\%$ of $\$850 =$

18. 3.6% of $\$480 =$

Number Quickies

1. A can containing 10 oz. of salted nuts sells for 85¢. At that rate, what is the cost a pound?

2. A school uses an average of 240 half-pints of milk in one school day. On the average, how many gallons of milk are used each day?

3. An airplane travels a distance of 150 mi. in 45 minutes. At that rate, what is its speed per hour?

4. One per cent of a meter is equal to how many centimeters?

5. Ten per cent of a kilometer is equal to how many meters?

6. Ten per cent of a centimeter is equal to how many millimeters?

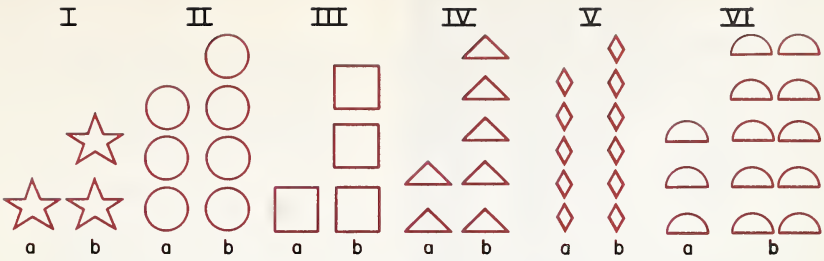
7. What is the smallest three-place whole number which can be divided by 7 without a remainder?

8. What is the product of $9 \times 8 \times 7 \times 0$?

9. The product of two fractions is $\frac{1}{6}$. If one of the fractions is $\frac{3}{4}$, what is the other fraction?

10. What number multiplied by .06 will give a product of 3?

11. Each Thursday Ruth has a music lesson for which she pays $1.25. If the first of March is on Tuesday, how much will it cost Ruth for the music lessons she takes on all of the Thursdays of that month?

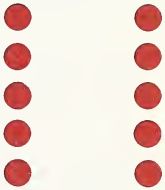


Expressing Ratios as Per Cents

1. Compare the number of objects in column **a** with the number of objects in column **b** in each of the above illustrations. Express the ratio as a common fraction.

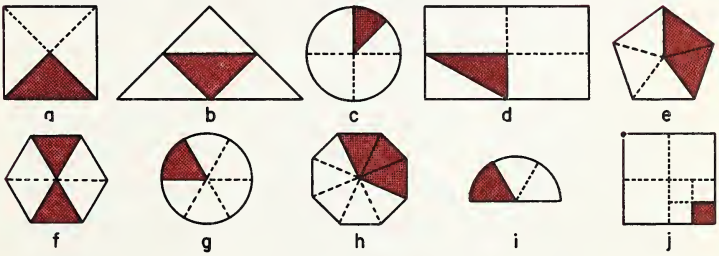
2. Express as a per cent the common fraction which represents the ratio of the number in **a** to the number in **b** in each of the above illustrations.

3. What is the ratio of the number of disks in one column to the number of disks in the other column in the drawing on the right?



4. In problem 3, the number in one column is what per cent of the number in the other column?

5. What per cent of the entire figure is shaded in each of the figures given below?



6. Draw a square and shade 25% of it.

★7. Draw a square and shade $12\frac{1}{2}\%$ of it.

★8. Draw a circle and shade $33\frac{1}{3}\%$ of it.

Finding What Per Cent One Number Is of Another Number

1. A basketball team attempted 50 shots at the basket and 17 of them were successful. What per cent of the shots that were made by the team were successful?

$\frac{17}{50}$ = the ratio of the number of successful shots to the total number of shots made.

The team was successful in 34% of its shots.

$$\begin{array}{r} .34 \\ 50\overline{)17.00} \\ .34 = 34\% \end{array}$$

Complete the division to show that the quotient is correct.

2. A team won 11 games of baseball and lost 9 games. What per cent of the games played did the team win?

There were 20 games played. The ratio of the number of games won to the number of games played was $\frac{11}{20}$.

$\frac{11}{20}$ = ? hundredths = ?%.

To find what per cent one number is of another: **Write the numbers as a fraction. The number to be compared is the numerator and the number with which it is to be compared is the denominator. Then change the fraction to a per cent.**

Find the missing numbers in the following examples:

	a	b	c
3.	7 = ?% of 10	9 = ?% of 20	3 = ?% of 15
4.	14 = ?% of 25	31 = ?% of 50	36 = ?% of 80
5.	21 = ?% of 30	48 = ?% of 60	75 = ?% of 90
6.	24 = ?% of 120	35 = ?% of 140	50 = ?% of 225
7.	7 = ?% of 16	5 = ?% of 12	11 = ?% of 14
8.	35 = ?% of 45	71 = ?% of 71	180 = ?% of 450
9.	1 = ?% of 40	3 = ?% of 200	7 = ?% of 500
10.	4 = ?% of 160	9 = ?% of 600	4 = ?% of 250

Applications of Per Cent

1. A family spends 35% of its income for food. If the yearly income is $2750, how much does the family spend for food?

2. A watch was reduced in price from $60 to $50. What was the per cent of reduction in price?

3. A wage earner received an increase of 15% in his hourly wage. If his old wages were $1.40 an hour, what were his new wages?

4. A wage earner who received $1.20 an hour was given an increase of 15¢ an hour. What was the per cent of increase in his wages?

5. A can holds 15 fluid ounces. The capacity of the can is what per cent of a pint? (1 qt. = 40 fl.oz.)

6. When the yearly subscription price of a magazine was increased from $4 to $4.50, what was the per cent of increase?

7. A team played 25 games and won 17 of them. What per cent of the games played did the team win?

8. A test contained 40 items and each score was given in per cents. If a student answered 32 questions correctly, what should be his score?

9. A basketball team attempted 96 shots at the basket. If 32 of them were successful, what per cent of the shots were successful?

Practise What You Have Learned in Percentage

	a	b	c
1.	8% of 45 =	$33\frac{1}{3}$% of 420 =	16% of 85 =
2.	4 = ?% of 25	15 = ?% of 120	24 = ?% of 30
3.	17 = ?% of 51	9% of 550 =	1.8% of 650 =
4.	5 = ?% of 80	10 = ?% of 400	3 = ?% of 250
5.	7.5% of 380 =	1.4% of 760 =	8 = ?% of 500
6.	$2\frac{1}{2}$% of 750 =	140 = ?% of 180	$87\frac{1}{2}$% of 1240 =
7.	$37\frac{1}{2}$% of 480 =	$33\frac{1}{3}$% of 720 =	3.7% of 260 =
8.	$66\frac{2}{3}$% of 510 =	$62\frac{1}{2}$% of 320 =	2.9% of 1450 =
9.	2.4% of 640 =	17 = ?% of 50	$16\frac{2}{3}$% of 480 =

★Rounding Off a Per Cent

1. When the price of a quart of milk increased from 17¢ to 19¢, what was the per cent of increase?

The increase was 2¢ a quart.

$\frac{2}{17}$ = Ratio of increase to former price

$$\frac{2}{17} = 17\overline{)2.0000}^{\,.1176}$$

The exact decimal value of the fraction $\frac{2}{17}$ cannot be determined. Correct to four decimal places, $\frac{2}{17} = .1176$.

Divide and show that the work given is correct.

.1176 = .12 to the nearest 0.01; .12 = 12%

.1176 = .118 to the nearest 0.001; .118 = 11.8%

$\frac{2}{17}$ to the nearest whole per cent is 12% and to the nearest tenth of a per cent, 11.8%.

You can see that the rules for rounding off a decimal fraction apply also in rounding off a per cent.

2. Round off each of the following to the nearest per cent:

a. 7.3% **b.** 1.5% **c.** 2.49% **d.** 13.4% **e.** 12.5% **f.** 1.95%

3. Round off to the nearest tenth of a per cent:

a. 3.25% **b.** 6.45% **c.** 1.54% **d.** 3.249% **e.** 1.025%

Find the missing per cents to the nearest tenth of a per cent.

	a	b	c
4.	3 = ?% of 7	5 = ?% of 6	8 = ?% of 11
5.	7 = ?% of 9	2 = ?% of 3	15 = ?% of 19
6.	20 = ?% of 27	1 = ?% of 30	25 = ?% of 55
7.	150 = ?% of 180	100 = ?% of 160	300 = ?% of 375

8. Show by approximation that the increase in problem 1 was about 12%. Think, "$\frac{2}{17}$ is equal to a little less than $\frac{1}{8}$, or $12\frac{1}{2}$%."

9. Show by approximation that:

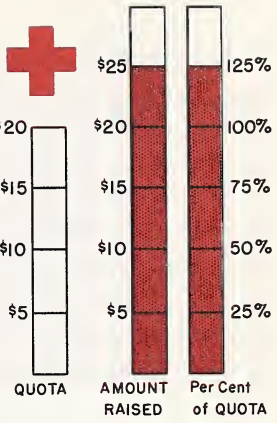
a. 11 is about 25% of 45

b. 41 is about 50% of 78

c. 35 is about 70% of 52

d. 28 is about $33\frac{1}{3}$% of 88

The Red Cross Goes over the Top



The schools of Fairlawn put on a drive for the Red Cross. Each school had a certain amount to raise, called its **quota**. The quota for the Bryant School was $20.

1. How much money did the Bryant School raise for the Red Cross?

2. What per cent represents the quota of the Bryant School?

3. What per cent of the quota was collected by the Bryant School?

4. If the quota for the Bryant School had been $26 and the school had collected 120% of its quota, how much would have been collected?

$$120\% = 1.20 = 1.2$$
$$1.2 \times \$26 = ?$$

5. Today the enrollment of the Bryant School is 130% of what it was 5 years ago. There were 420 students enrolled 5 years ago. How many are enrolled today?

Find the following percentages:

6. 120% of 46 =
7. 115% of 32 =
8. 200% of 17 =
9. 102% of 450 =
10. 175% of 640 =
11. 150% of 85 =
12. 124% of 140 =
13. 100% of 31 =
14. 101% of 780 =
15. 105% of 920 =

16. We know that $1 = 1.00 = 100\%$. Likewise, $1\frac{1}{2} = 1.5 = 1.50 = 150\%$. Explain each step in the two solutions.

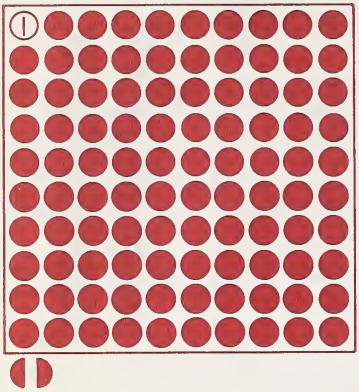
17. Express as per cents:

a. 2 b. 1.8 c. $2\frac{1}{2}$ d. 2.05 e. $1\frac{1}{4}$ f. 3

18. Express in decimal form:

a. 500% b. 120% c. 104% d. 250% e. 180%

MORE PRACTICE



Finding a Fractional Per Cent of a Number

1. How many disks are missing from the 100-board? What per cent of the disks is missing?

2. Each disk represents what per cent of the total number of disks that the board will hold?

3. Nancy took the one disk which is missing and broke it into halves as shown on the left. Each half disk now represents $\frac{1}{2}$ per cent, or $\frac{1}{2}\%$.

$\frac{1}{2}$ per cent means $\frac{1}{2}$ of 1 per cent

4. Find $\frac{1}{2}\%$ of 200.

Think: "1% of 200 = .01 × 200 = 2.
Then, $\frac{1}{2}\%$ of 200 = $\frac{1}{2}$ of 2, or 1."

5. Find $\frac{1}{2}\%$ of 600; of 400; of 500; of 1200.

6. Find $\frac{1}{2}\%$ of 740.

1% of 740 = .01 × 740 = 7.40
Then, $\frac{1}{2}\%$ of 740 = $\frac{1}{2}$ of 7.4, or 3.7.

To find a fractional part of one per cent of a number, first find 1% of the number; then multiply the result by the fraction.

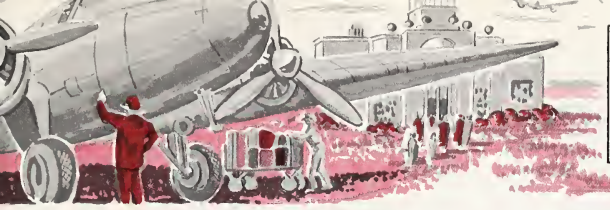
Find the following percentages:

	a	b	c
7.	$\frac{1}{2}\%$ of 350 =	$\frac{1}{2}\%$ of 960 =	$\frac{1}{3}\%$ of 600 =
8.	$\frac{1}{4}\%$ of 840 =	$\frac{1}{10}\%$ of 1250 =	$\frac{1}{5}\%$ of 750 =
9.	$\frac{1}{2}\%$ of 320 =	.4% of 250 =	.1% of 900 =
10.	.2% of 800 =	.3% of 1120 =	.5% of 460 =

11. A collecting agency charges .1% of a bill to collect the money. Find the charge to collect $450; $180; $1250.

★12. Since 1 disk out of 100 disks represents 1%, $\frac{1}{2}\%$ is equal to 1 disk out of how many disks? $\frac{1}{3}\%$ is equal to 1 disk out of how many disks?

MORE PRACTICE



Cost of Extra Baggage on an Airplane

When John was at the airport last summer, he saw a sign like the one in the picture above. He learned that for any number of pounds of baggage over the free amount, the charge per pound was $\frac{1}{2}\%$ of the fare.

1. How many pounds of baggage was a passenger allowed free?

2. If a passenger had 50 pounds of baggage and his ticket cost $28.40, what was the charge for transporting his baggage?

50 lb. − 40 lb. = 10 lb., number of pounds on which there was a charge

$\frac{1}{2}\%$ of \$28.40 = $\frac{1}{2}$ of 1% of \$28.40

.01 × \$28.40 = 28.4¢; $\frac{1}{2}$ of 28.4¢ = 14.2¢, charge for 1 lb.

10 × 14.2¢ = \$1.42, charge for 10 lb. of extra baggage.

3. At the rate given in problem 2, find the charge for transporting the baggage if the passenger had 56 pounds of baggage.

Find the missing numbers in the table.

Problem	Pounds of Baggage a	Passenger's Fare b	Cost per Pound of Baggage c	Cost of Extra Baggage d	Cost of Fare and Baggage e
4.	48	\$25.00	?	?	?
5.	65	\$58.40	?	?	?
6.	55	\$83.20	?	?	?
7.	60	\$49.80	?	?	?
8.	37	\$92.50	?	?	?
9.	64	\$103.00	?	?	?

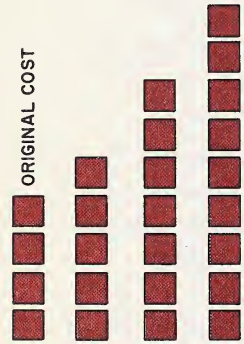
Per Cent of Increase or Decrease

1. Copy the table and supply the missing numbers.

1 out of 100 = 1%	1 out of 5 = ?%
1 out of 50 = 2%	1 out of 4 = ?%
1 out of 25 = ?%	1 out of 3 = ?%
1 out of 20 = ?%	1 out of 2 = ?%
1 out of 10 = ?%	1 out of 1 = ?%

2. How does the per cent which 1 is of a group change as the number in the group decreases? How does the per cent change as the number in the group increases?

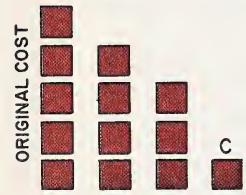
3. If the four blocks in the first column on the left represent the cost of a sweater, what per cent does each block represent?



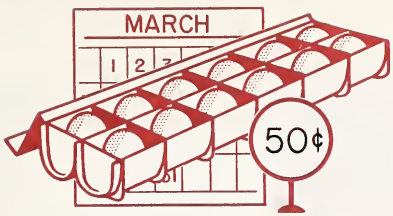
4. In the diagram for problem 3, the blocks in columns A, B, and C show the cost of the sweater after it was increased in price three different times. How many blocks show the increase in price in column A? in column B? in column C? Find the per cent of increase over the original price in column A; in column B; in column C.

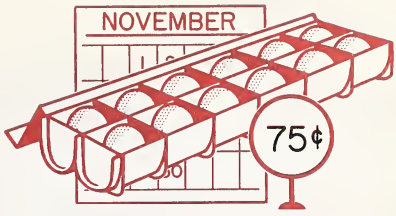
5. How many times as much as the original price is the price represented in column C?

6. The five blocks in the first column of the diagram below represent the cost of a hat. Columns A, B, and C represent the cost of the hat after it has been reduced in price three different times. How many blocks represent the reduction in price in column A? in column B? in column C? What is the per cent of decrease of the original price in column A? in column B? in column C?



★7. From your study of the two diagrams, show why there can be more than 100% increase in the price of an object; show why there can never be a decrease of 100% in the price of something sold.





Finding Per Cent of Change

1. What was the cost of a dozen eggs in March? in November?

2. What was the per cent of increase in the price of a dozen eggs from March to November?

3. If the price of a dozen eggs was 75¢ in November and 50¢ in the following March, what was the per cent of reduction in price?

4. In problems 2 and 3 the change in price was the same, but the per cent of change was different. Why?

To find the per cent of change between two numbers, find the difference and compare this difference with the number before the change.

Find the per cent of change in each of the following:

	a	b	c
5.	From 60 to 90	From 90 to 60	From 45 to 30
6.	From 50 to 54	From 36 to 30	From 80 to 70
7.	From 25 to 58	From 20 to 47	From 48 to 32
★8.	From 2.5 to 2.8	From 2.5 to 1.9	From 7.5 to 5
★9.	From $\frac{1}{2}$ to $\frac{1}{4}$	From $\frac{1}{4}$ to $\frac{1}{2}$	From $\frac{3}{8}$ to $\frac{1}{4}$

10. All of the employees of a large city received an increase in salary of 5%. Was the increase in salary the same amount for all employees? Give the reason for your answer.

★11. In problem 10, if the employees had received a 5% reduction in salary, would the amount of the reduction have been the same as the amount of the increase? Give an illustration to prove your answer.

★12. When the price of an article doubles, what is the per cent of increase in price? The increased price is what per cent of the former price?

MORE PRACTICE

The Value of Milk Depends on Its Butterfat

Most dairy farmers sell milk by the hundredweight (100 lb.), which is approximately equal to 43 quarts. The price usually quoted assumes that milk is of standard grade, which means that it contains 3.5% butterfat. For each one tenth of one per cent (0.1%) of butterfat above or below 3.5%, there is an increase or a decrease from the quoted price of milk.

1. Allowing 5¢ for each tenth of a per cent of butterfat above standard grade, how much does a farmer receive for 100 pounds of milk which tests show contains 3.9% butterfat at the price quoted?

3.9% − 3.5% = .4%

The butterfat of the milk is .4% above standard-grade milk.

.4% is equal to 4 points which have a value of 5¢ each.

4 × 5¢ = 20¢, the extra allowance for butterfat.

$5.17 + $.20 = ?, the price for 100 lb. of 3.9% milk.

2. How much below standard grade is milk which tests 3.2% butterfat? 3% butterfat?

3. At the rate of 5¢ for each tenth of a per cent of butterfat below standard-grade milk, how much would be deducted from the price of standard-grade milk for milk which tests 3.2% butterfat? for milk testing 3% butterfat?

4. To the nearest hundredth of a pound, what is the weight of a quart of milk if there are 43 quarts in 100 pounds of milk?

5. How much above standard-grade milk is milk which tests 4.1% butterfat? 4.4% butterfat?

6. At the rate of 6¢ for each tenth of a per cent of butterfat above standard-grade milk, how much would be added to the price of standard-grade milk on 100 pounds of milk that tests 4.2% butterfat? on 100 pounds of milk that tests 4.6% butterfat?

7. Suppose that milk contains 4.2% butterfat. At 4¢ per 100 pounds for each .1% above standard grade, what is the price of 100 pounds of this milk when the price per 100 pounds of milk testing 3.5% butterfat is $5.32?

Problem	Per Cent of Butterfat	Price per 100 lb. of Standard Grade	Allowance for Each .1% of Butterfat	Price Farmer Receives for 100 lb. of Milk
8.	3.5%	$5.34	5¢	?
9.	4.2%	$4.86	5¢	?
10.	3.8%	$4.79	5¢	?
11.	3.4%	$4.61	4¢	?
12.	?	$5.12	5¢	$5.22
13.	?	$4.77	4¢	$4.65
14.	4.4%	?	4¢	$5.27

15. A dairyman produces an average of 240 pounds of 3.5% milk daily which he sells at $5.35 per 100 pounds. What is his daily income from the milk?

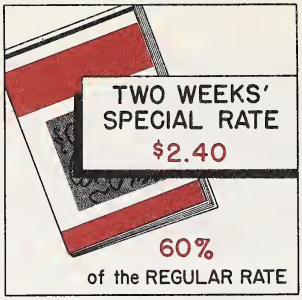
16. A dairyman sells an average of 350 pounds of 3.5% milk daily at $5.28 per 100 pounds. What is his income from the milk during the month of November?

17. If it takes .8 pound of butterfat to make 1 pound of butter, how many pounds of butter can be made from:

a. 2 lb. of butterfat?
b. 10 lb. of butterfat?
c. 60 lb. of butterfat?
d. 100 lb. of butterfat?

How can you find out what else besides butterfat goes into the making of butter?

★18. Why should the price of milk change as the per cent of butterfat it contains changes?



Finding a Number When a Per Cent of It Is Given

1. Jim subscribed to a magazine at the special rate shown. What was the regular subscription price?

The Decimal Fraction Way	The Common Fraction Way
60% = .60 = .6 .6 × regular price = $2.40 Then the regular price = $2.40 ÷ .6 $4.00 .6)$2.40 = 6)$24.00 Regular price = $4.00 Check: 60% of $4.00 = .6 × $4.00 or $2.40	$\frac{3}{5}$ of the regular price = $2.40 Then the regular price = $2.40 ÷ $\frac{3}{5}$ $2.40 ÷ $\frac{3}{5}$ = $2.40 × $\frac{5}{3}$, or $4.00 The regular price = $4.00 or: $\frac{3}{5}$ of regular price = $2.40 $\frac{1}{5}$ of regular price = $\frac{1}{3}$ of $2.40 = 80¢ $\frac{5}{5}$ of regular price = 5 × 80¢ = $4.00. Check: $\frac{3}{5}$ of $4.00 = $2.40.

To find a number when a per cent of it is given, change the per cent to a decimal fraction or to a common fraction and divide the given number by this fraction.

Find the missing numbers. Check by multiplication.

MORE PRACTICE

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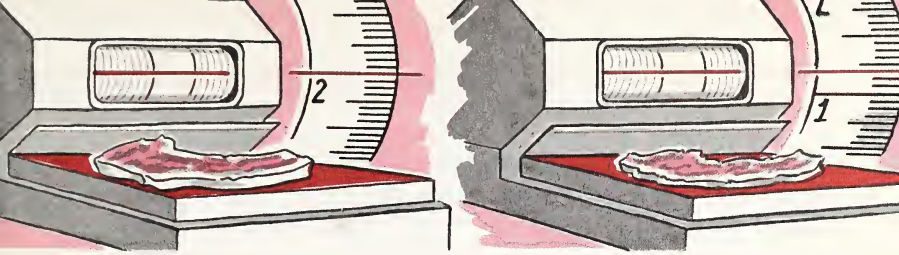
	a	b	c
2.	.4 of ? = 36	.2 of ? = 10	.3 of ? = 45
3.	10% of ? = 40	20% of ? = 18	25% of ? = 48
4.	5% of ? = 80	40% of ? = 60	15% of ? = 75
5.	3% of ? = 39	8% of ? = 72	1% of ? = 9.5
6.	72 = 90% of ?	56 = 80% of ?	120 = 25% of ?



Waste Makes Meat Very Expensive

The picture shows a rib steak which lost 13 ounces in broiling. Prove that the loss was about 40%.

Besides loss in cooking of meats, there is loss due to waste. The table gives the cost per pound of different cuts of meat and of certain fowl. The table also shows the per cent of cooked food that is fit to serve. Fill in the rest of this table.

Find the per cent of loss of each item.

The cost for a pound of each item is found by dividing the cost per pound of the raw food by the decimal part of the food that is fit to serve. The cost per pound of rib roast is found as follows:

45% of ? = 78¢; .45 × ? = 78¢

78¢ ÷ .45 = $1.73, to the nearest cent.

Kind of Meat	Cost per Pound at Store	Per Cent of Food to Serve	Per Cent of Loss in Cooking and in Waste	Cost per Pound at the Table
A. Beef				
1. Rib roast (medium)	$.78	45%	55%	$1.73
2. Stew	$.56	70%	?	?
B. Lamb				
3. Leg, roast	$.90	40%	?	?
C. Fowl				
4. Broiler	$.60	60%	?	?
5. Turkey	$.58	65%	?	?

★ Finding a Number When a Per Cent of Increase Is Given

1. Mr. Burton said, "Our living expenses have increased 20% in the last 5 years." If the Burton family spends $60 a week for living expenses today, what were their living expenses 5 years ago?

a. On the diagram, what represents the expenses 5 years ago? What per cent is this?

b. The expenses today are what per cent of the amount 5 years ago?

The diagram shows that the living expenses today are $60 a week, which is 120% of what they were 5 yr. ago.

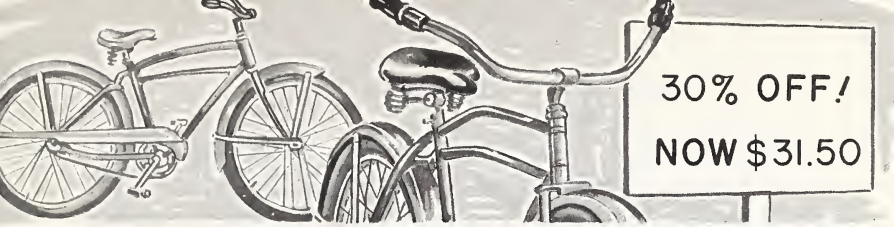
$120\% = 1.20 = 1.2$
$1.2 \times$ the amount 5 yr. ago $= \$60$
$1.2 \times ? = \$60$
$\$60 \div 1.2 = ?$
$\$60 \div 1.2 = \$50$

Living expenses 5 years ago were $50.

Check: 120% of $50 = $1.2 \times \$50 = \$60$.

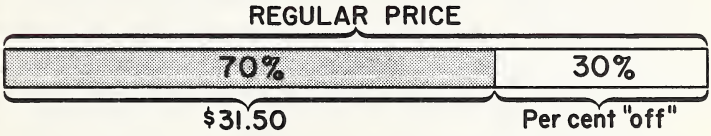
Find the missing numbers. Check by multiplication.

2. 120% of ? = 48
3. 150% of ? = 75
4. 110% of ? = 55
5. 60 = 125% of ?
6. 10% more than ? = 88
7. 20% more than ? = 72
8. 50% more than ? = 450
9. 40% more than ? = 56
10. 30% more than ? = 91
11. 100% more than ? = 34
12. 360 = 200% more than ?
13. 96 = 20% more than ?
14. 180 = 25% more than ?
15. 480 = 60% more than ?



★ Finding a Number When a Per Cent of Decrease Is Given

1. The bicycle sells for what per cent less than the regular price?
2. What is the regular price of the bicycle?



a. On the diagram, what represents the regular price of the bicycle? What per cent is this?

b. What per cent of the regular price is the sales price?

The graph shows that $31.50 is 70% of the regular price.

70% of the regular price = $31.50

$.7 \times ? = \$31.50$ $\quad \$31.50 \div .7 = ?$

$$\$\ 45.00$$

$.7\overline{)\$31.50} = 7\overline{)\$315.00}$

$\$31.50 \div .7 = \$45$

The regular price is $45.

Check: 70% of $45 = $.7 \times \$45 = \$31.50$.

Find the missing numbers. Check by multiplication.

3. 20% less than ? = 60
4. 10% less than ? = 36
5. 25% less than ? = 75
6. 50% less than ? = 80
7. 30% less than ? = 140
8. 15% less than ? = 370
9. 40% less than ? = 240
10. 240 = 60% less than ?
11. 400 = 20% less than ?
12. 130 = 65% less than ?

Practise What You Have Learned

1. $\begin{array}{r} 4.75 \\ 3.98 \\ 2.57 \\ 0.64 \\ \underline{8.50} \end{array}$

2. $\begin{array}{r} 37{,}124 \\ \underline{-18{,}567} \end{array}$

3. $\begin{array}{r} 6\frac{1}{4} \\ \underline{-1\frac{2}{3}} \end{array}$

4. $\begin{array}{r} .97 \\ \underline{\times 4.5} \end{array}$

5. $\begin{array}{r} 8\frac{1}{2} \\ 2\frac{5}{6} \\ 3\frac{1}{4} \\ \underline{7\frac{2}{3}} \end{array}$

6. $27\overline{)82156}$

7. $3.4\overline{).85}$

8. $5\overline{).12}$

9. $3\frac{1}{2} \times 6\frac{1}{4} =$

10. $7\frac{1}{3} \div \frac{4}{5} =$

11. $\frac{3}{4} \times 5\frac{1}{2} \times 7\frac{1}{3} =$

12. 5% of 84 =

13. 2.4% of 560 =

14. $\frac{1}{2}$% of 780 =

15. 16 = ?% of 48

16. 45 = ?% of 30

17. 1 = ?% of 20

18. 5 = 4% of ?

19. 20% of ? = 72

20. 360 = 12% of ?

Number Quickies

1. A pint is what per cent of a gallon?

2. A peck is what per cent of a bushel?

3. A fluid ounce is what per cent of a pint?

4. Express 24 minutes as a decimal part of an hour.

5. Lemons sell at 3 for 14¢. At that rate, what is the cost of a dozen?

6. How many centimeters are there in .75 meter? in 1.2 meters?

7. If a kilometer is equal to approximately $\frac{5}{8}$ of a mile, how many kilometers are there in 120 miles?

8. It is estimated that 1 out of every 25 persons is left-handed. At that rate, the number of people who are left-handed is what per cent of the number of all people?

9. When Ted had sold 15 papers, he had sold 25% of the number he had to sell. How many papers did he have to sell?

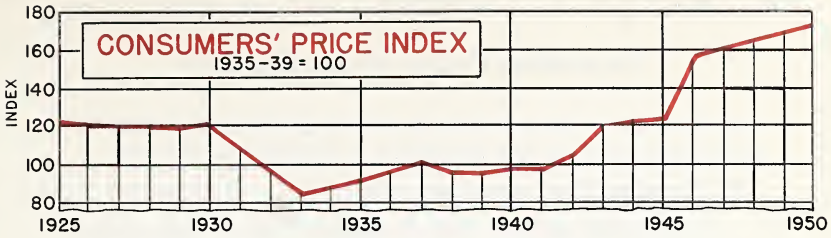
10. A reservoir 60% full contains 12 billion gallons. How many gallons will the reservoir hold when filled?

11. A meter is what per cent of a kilometer?

12. An inch is what per cent of a foot?

13. A millimeter is what per cent of a centimeter?

14. A tank $\frac{3}{8}$ full contains 450 gallons. How many gallons will the tank hold when completely filled?



A Quarter-Century of Change in Living Costs

The graph shows the average price the consumer had to pay for commodities he purchased over a period of 25 years. The **index** indicates the average price in per cent with the per cent sign missing. The average cost of all commodities during the 5-year period from 1935–39 is used to represent an index of 100 or 100%. The index of prices for 1925 was 125, or 125% of the 1935–39 prices. Thus, commodities that cost $50 in 1935–39 would have cost 125% of $50, or $62.50 in 1925.

1. Approximately what per cent of the average cost of commodities for 1935–39 was the cost in 1930? in 1940? in 1950?

2. According to the graph, during which year was the cost of commodities the lowest? During which year was the cost of commodities the highest?

3. For each dollar spent for commodities in 1940, about how much was it necessary to spend to receive the same amount of commodities in 1925? in 1945? in 1950?

4. Commodities that cost $30 in 1935–39 would have cost about how much in 1925? in 1940?

5. Living costs are high when people have to spend more money for necessities than they usually spend for them. In which 5-year period, beginning with 1925, were living costs highest? In which 5-year period were they lowest?

6. How does war affect living costs? How is this shown on the graph?

★ 7. What is meant by price controls? During World War II, there were price controls on many commodities, but these controls were removed after the war. How does the graph show this? Are there price controls now?

Important Points about Per Cent

A. In order to use per cents in solving problems, it is necessary to change a per cent to a decimal or a decimal to a per cent.

B. There are three uses of per cent:

1) Finding a per cent of a number; as 3% of 75 = ? See 1.
2) Finding what per cent one number is of another number; as 6 = ?% of 25. See 2.
3) Finding a number when a per cent of it is given; as 12 = 4% of ? See 3.

C. We round off a per cent in the same way that we round off whole numbers or decimals.

1. Finding a per cent of a number

Find 3% of 75.

3% = .03 $\qquad$ .03 × 75 = 2.25

Find the missing numbers:

a. 15% of 86 = $\qquad$ c. 240% of 95 = $\qquad$ e. $\frac{1}{2}$% of 750 =

b. 2.4% of 120 = $\qquad$ d. $37\frac{1}{2}$% of 420 = $\qquad$ f. $1\frac{1}{2}$% of 1200 =

2. Finding what per cent one number is of another number

Find what per cent 6 is of 25.

$\frac{6}{25} = 25\overline{)6.00} = 24\%$ $\qquad$ 6 = 24% of 25

Find the missing per cents:

a. 3 = ?% of 5 $\qquad$ c. 3 = ?% of 40 $\qquad$ e. 3 = ?% of 200

b. 5 = ?% of 3 $\qquad$ d. 12 = ?% of 4 $\qquad$ f. 37.5 = ?% of 75

3. Finding a number when a per cent of it is given

Find a number when 4% of it is 12.

12 = 4% of ? $\qquad$ 12 ÷ .04 = 300

Find the missing numbers:

a. 45 = 5% of ? $\qquad$ c. 150% of ? = 600 $\qquad$ e. 1% of ? = 40

b. 75 = 3% of ? $\qquad$ d. 120% of ? = 480 $\qquad$ f. $33\frac{1}{3}$% of ? = 45

Diagnostic Test in Per Cent

I. Express the following in decimal form or as whole numbers: (370)

1. 30%	3. 400%	5. 102%	7. 3%
2. 140%	4. 2.5%	6. 35%	8. $37\frac{1}{2}\%$

II. Change the following to per cents: (370)

1. .4	3. .52	5. .035	7. 1.025
2. 1.2	4. 1.03	6. .012	8. 1.45

III. Change to common fractions expressed in lowest terms: (370)

1. 75%	3. $37\frac{1}{2}\%$	5. 5%	7. 60%
2. $66\frac{2}{3}\%$	4. 40%	6. 10%	8. 4%

IV. Change to per cents: (370)

1. $\frac{1}{2}$	3. $\frac{4}{5}$	5. $\frac{7}{10}$	7. $\frac{3}{25}$
2. $\frac{1}{4}$	4. $\frac{5}{8}$	6. $\frac{3}{20}$	8. $\frac{7}{50}$

V. Find the per cent of the number as indicated:

a	b	c	
1. 4% of 60 =	15% of 80 =	70% of 25 =	(370)
2. 3.2% of 95 =	102% of 560 =	300% of 55 =	(370)
3. $\frac{1}{2}\%$ of 480 =	$1\frac{1}{2}\%$ of 920 =	$\frac{1}{5}\%$ of 1200 =	(370)

VI. Find what per cent one number is of the other, as indicated:

1. 4 = ?% of 16	15 = ?% of 45	12 = ?% of 40	(370)
2. 15 = ?% of 6	12 = ?% of 8	70 = ?% of 35	(370)

VII. Find the number when the per cent of it is given as indicated:

1. 5% of ? = 80	15% of ? = 75	3% of ? = 60	(371)
2. 110% of ? = 55	\$60 = 120% of ?	600 = 150% of ?	

Check your answers with those given on pages 352-353. If you had more than one example incorrect in any group, review the Study Helps on page 114. For practice, turn to the page number given in the parentheses.

How to Make Money for Christmas

Malcolm bought 1000 Christmas cards for $28. He sold them in boxes, each containing 25 cards, at $1.50 a box.

1. How many boxes of 25 cards each did Malcolm have?

2. How much was the average cost per card of the cards he bought?

3. If Malcolm had to pay 5¢ for an empty box, what was the total cost of a box of 25 cards?

4. How much did Malcolm receive for the 1000 cards at the rate given above if he sold all of them?

5. How much more than he paid for all of the cards and boxes did Malcolm receive? This amount is **profit** because Malcolm had no other expenses in operating his business.

6. What per cent of the total cost of the 1000 cards and boxes was the profit? What per cent of the selling price was the profit?

7. In this case, the difference between the cost of cards and boxes and the selling price was profit, because there were no expenses in operating the business. Are most businesses operated this way?

8. Profit is the difference between cost (c) and selling price (s.p.). In each of the following, find what per cent the profit is of the cost; of the selling price.

a. S.p., $15; c., $9 **c.** S.p., $36; c., $20 **e.** S.p., $75; c., $60
b. S.p., $24; c., $16 **d.** S.p., $60; c., $12 **f.** S.p., $80; c., $50

Selling Price Minus Cost Is Not Always Profit

George operates a florist shop. This shop specializes in roses for both **wholesale** and **retail** trade. Wholesale trade is with other florists, while retail trade is with individual customers.

1. If the wholesale price of 100 roses is $7.50, what is the average price of one rose? What is the average price of a dozen?

2. George buys certain kinds of roses at $1.50 a dozen. He retails the roses at $3 a dozen. The difference between the cost of the roses and the price at which he sells them is the **margin** or **mark-up**. How much is the mark-up?

3. In problem 2, the mark-up is what per cent of the cost? what per cent of the selling price?

4. The margin or mark-up is not all profit. George has many expenses in operating his business. His profit is the difference between the margin and the expenses. George delivers flowers. How does the cost of this service affect his expenses? How does it affect his profit? What are some of the other expenses of operating a florist's shop besides buying the flowers?

5. When a florist's profit averages 10% of the selling price, he has a successful business. At that rate, how much should his profit be on a poinsettia plant which sells for $1? If the cost of the poinsettia is 50¢, what does the other 40¢ of the selling price include?

If the profit is 10% of the selling price, find the missing numbers:

	Cost	Mark-up	Selling Price	Expenses	Profit
6.	$5.00	?	$8.00	?	?
7.	$3.00	?	$6.00	?	?
8.	?	$4.00	$10.00	?	?
9.	$2.50	$1.50	?	?	?
★10.	?	?	?	$2.80	$1.20

The Sales-Dollar

Each dollar of income that George receives from the sale of flowers is called the **sales-dollar**, which is divided as shown.

Selling price = cost + profit + expenses.

1. From the graph, what per cent of George's sales-dollar is cost? What per cent of his sales-dollar is mark-up?

2. From the graph, George's expenses are what per cent of the mark-up? What per cent of his sales-dollar?

3. From the graph, George's profit is what per cent of the mark-up? What per cent of his sales-dollar?

4. When the expenses are more than the mark-up, there is a **loss.** If the mark-up is $30, and the expenses are $32.75, what is the loss?

Find the missing numbers in the table:

	Cost	Mark-up	Expenses	Profit	Loss	Selling Price
5.	$27.25	?	$6.40	$2.35		?
6.	$3.90	$1.15	$0.68	?		?
7.	$ 9.37	$6.13	$4.27	?		?
8.	?	$21.25	?	$6.35		$72.50
9.	$12.40	?	$3.65		?	$12.95
10.	?	$6.50	$7.46		?	$22.75

★11. When the mark-up is equal to the cost, the mark-up is what per cent of the selling price?

★12. When the mark-up is half of the cost, the mark-up is what per cent of the selling price?

Buying at a Discount

The coach of the Fraser High School football team orders the supplies for his team from the catalogue of a sporting goods store. On equipment which he purchases he receives a **discount** on the **list price** given in the catalogue. The cost of the article after the discount is subtracted is called the **net cost.**

1. The list price of a football is $26. If the coach is given a 25% discount, what is the net cost of the football?

25% of $26 = ?
.25 × $26 = $6.50
$26.00 − $6.50 = $19.50

25% = $\frac{1}{4}$
$\frac{1}{4}$ × $26 = $6.50
$26.00 − $6.50 = $19.50

The net cost of the football is $19.50.

2. In problem 1, the net cost is what per cent of the list price?

3. When a discount of 30% is given, the net cost is what per cent of the list price?

4. When only one discount is given, prove that the per cent of the net cost is equal to 100% of the list price less the per cent of discount.

Find the missing numbers in the table:

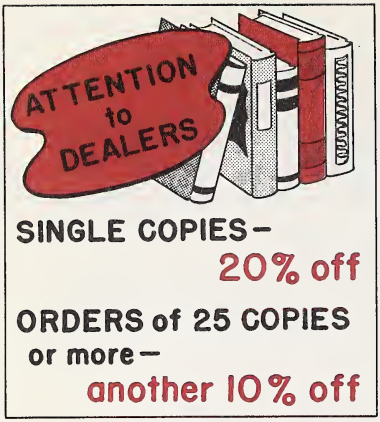
	List Price	Per Cent of Discount	Net Cost
5.	$60	30%	?
6.	$7.50	20%	?
7.	$10	?	$7.50

	List Price	Per Cent of Discount	Net Cost
8.	$25	?	$19.50
★9.	?	20%	$12
★10.	?	30%	$35

11. An operator of a bookstore is given a discount of 25% on a book which is listed at $3. If he retails the book at $2.75, what is his margin?

12. The net cost of athletic equipment listed at $960 was $768. What was the per cent of discount?

★ 13. John bought a football at a net cost of $16. This was 80% of the list price. What was the list price?



It Is Cheaper to Order in Large Quantities

Mr. Thomas, who operates the Corner Book Store, received from a large publishing company a copy of the circular shown on the left. This publisher offered two discounts on the list price in order to encourage large orders. Two or more discounts given on sales are called **successive discounts.**

1. Mr. Thomas ordered 25 copies of a new cook book which was listed at $3.50. If the publisher gave the discounts shown above, what was the net cost of each book?

20% = .20 = .2
.2 × $3.50 = $.70
$3.50 − $.70 = $2.80
$2.80 = Net cost after the first discount

10% = .10 = .1
.1 × $2.80 = $.28
$2.80 − $.28 = $2.52
$2.52 = Net cost after the second discount

The net cost of each book was $2.52.

2. The net cost of a $3.50 book is how much less when one discount of 30% is given than when two successive discounts of 20% and 10% are given?

Find the net cost of each of the following:

	List Price	Discounts		List Price	Discounts		List Price	Discounts
3.	$75	20%, 10%	5.	$300	15%, 10%	7.	$96	$33\frac{1}{3}$%, 20%
4.	$50	25%, 10%	6.	$740	25%, 5%	8.	$65	10%, 10%

9. Solve examples 3 and 4 and show that the order in which the discounts are deducted does not affect the net cost.

★10. Goods are listed at $750. Show that the net cost after deducting discounts of 20% and 10% is equal to .8 × .9 × $750. Explain how the decimals are found.

Vocabulary of Arithmetic

Define, illustrate, or use correctly in a sentence each of the following terms. If you have difficulty, refer to the key page number in parentheses, where the term is introduced.

Centimeter	(78)	Net cost	(119)
Discount	(119)	Per cent of change	(105)
Horizontal scale (graph)	(59)	Profit	(116)
Kilogram	(80)	Ratio	(36)
Kilometer	(78)	Retail price	(117)
List price	(119)	Sales-dollar	(118)
Majority	(32)	Scale (graph)	(59)
Margin	(117)	Successive discounts	(120)
Mark-up	(117)	Vertical scale (graph)	(59)
Meter	(78)	Wholesale price	(117)

Selecting the Most Sensible Answer

In the following exercise, four numbers are given after each example. None of the answers is correct, but one answer is closer to the correct answer than any of the others. By use of approximation, select the number that is nearest to the correct answer from the four numbers given. Study the sample to see the method to use.

1. 38% of 750: 30, 300, 375, 75.

Think, "38% is equal to approximately 40%. $.4 \times 750 = 300$. Hence, 300 is nearest the correct answer."

2. 24% of 850: 85, 175, 200, 250.
3. 19 = ?% of 49: 40%, 4%, 50%, 75%.
4. 351 = ?% of 508: 70%, 7%, 140%, 30%.
5. 73% of 821: 500, 600, 60, 650.
6. 60 = 32% of ?: 20, 30, 50, 175.
7. 150 = 47% of ?: 300, 75, 750, 33.
8. 195 = ?% of 208: 50%, 200%, 100%, 125%.
9. 111% of 450: 500, 400, 440, 550.
10. 385 = ?% of 195: 50%, 150%, 200%, 250%.

Getting Ready for the Progress Test in the Fundamentals

I. Add:

1. $\begin{array}{r} .645 \\ .158 \\ .064 \\ \underline{.133} \end{array}$

2. $\begin{array}{r} 7\frac{1}{3} \\ 4\frac{1}{2} \\ 2\frac{5}{6} \\ \underline{3\frac{3}{4}} \end{array}$

3. $\begin{array}{r} 1.85 \\ 3.96 \\ 7.57 \\ \underline{9.48} \end{array}$

4. $\begin{array}{r} 5 \text{ doz. } 8 \text{ units} \\ 3 \text{ doz. } 6 \text{ units} \\ \underline{4 \text{ doz. } 9 \text{ units}} \end{array}$

II. Subtract:

1. $\begin{array}{r} 7436 \\ \underline{6875} \end{array}$

2. $\begin{array}{r} 50{,}132 \\ \underline{40{,}576} \end{array}$

3. $\begin{array}{r} 6\frac{1}{4} \\ \underline{4\frac{1}{2}} \end{array}$

4. $\begin{array}{r} 9 \\ \underline{2\frac{5}{8}} \end{array}$

5. $\begin{array}{r} 7\frac{1}{3} \\ \underline{2\frac{3}{4}} \end{array}$

6. $\begin{array}{r} .375 \\ \underline{.195} \end{array}$

7. $\begin{array}{r} 9.32 \\ \underline{8.75} \end{array}$

8. $\begin{array}{r} 4\frac{1}{8} \\ \underline{3\frac{1}{2}} \end{array}$

9. $\begin{array}{r} 4 \text{ min. } 16 \text{ sec.} \\ \underline{2 \text{ min. } 25 \text{ sec.}} \end{array}$

III. Multiply:

1. $\begin{array}{r} 496 \\ \underline{8} \end{array}$

2. $\begin{array}{r} 375 \\ \underline{56} \end{array}$

3. $\begin{array}{r} 906 \\ \underline{407} \end{array}$

4. $\begin{array}{r} 760 \\ \underline{70} \end{array}$

5. $\begin{array}{r} 2009 \\ \underline{400} \end{array}$

6. $3\frac{1}{2} \times 7 =$

7. $\frac{3}{4} \times 2\frac{1}{2} =$

8. $\frac{5}{6} \times \frac{3}{4} =$

9. $1\frac{1}{2} \times 2\frac{2}{3} =$

10. $\begin{array}{r} 74 \\ \underline{.6} \end{array}$

11. $\begin{array}{r} 7.6 \\ \underline{4.5} \end{array}$

12. $\begin{array}{r} 58 \\ \underline{2\frac{5}{6}} \end{array}$

13. $\begin{array}{r} 4.8 \\ \underline{.07} \end{array}$

14. $\begin{array}{r} 3.14 \\ \underline{200} \end{array}$

15. 5% of 760 =

16. 2.8% of 96 =

17. $\frac{1}{2}$% of 940 =

IV. Divide:

1. $7\overline{)3104}$

2. $27\overline{)86134}$

3. $360\overline{)73145}$

4. $16\overline{)8144}$

5. $.3\overline{)72}$

6. $2.5\overline{).4}$

7. $1.5\overline{).45}$

8. $4\overline{)42}$

9. $\frac{1}{2} \div 1\frac{1}{2} =$

10. $2\frac{1}{4} \div 9 =$

11. $1\frac{3}{4} \div 5\frac{1}{2} =$

12. 15 = ?% of 75

13. 40 = ?% of 30

14. 1 = ?% of 200

15. 30 = 6% of ?

16. 75 = 150% of ?

17. 1% of ? = 2

Chapter Test

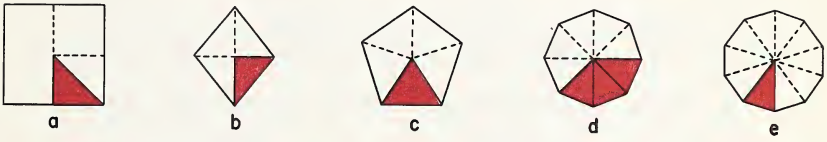
1. Express as per cents:

   a. .14 b. 1.6 c. $\frac{5}{8}$ d. $1\frac{1}{2}$ e. 3 f. 1.02

2. Express in decimal form:

   a. 5% b. 200% c. 104% d. 240% e. 2.6%

3. What per cent of each of the following figures is shaded?



Find the missing numbers:

4. 120% of 540 = ?
5. 3.4% of 180 = ?
6. $\frac{1}{2}$% of 1600 = ?
7. 4 = ?% of 25
8. 12 = ?% of 8
9. 16 = 20% of ?

10. On a test of 25 words, Peggy had 84% correct. How many words did she misspell?

11. A team won 13 games and lost 7 games. What per cent of the games played did the team win? What per cent did they lose?

12. Find the net cost of goods listed at $420 if successive discounts of 20% and 10% are given?

13. An airline charges $\frac{1}{2}$% of a passenger's fare for each pound of baggage over 40 pounds. A passenger's fare is $38 and he has 50 pounds of baggage. How much does he have to pay for shipping his baggage?

14. If only 60% of the weight of raw meat remains after it is prepared for serving at the table, what is the cost a pound of the meat actually served when the cost of the raw meat is 75¢ a pound?

15. What is the change from 50 to 60? the per cent of change?

16. What is the change from 60 to 50? the per cent of change?

17. In problems 15 and 16, the amount of change is the same. Why are the per cents of change different?

Progress Test in the Fundamentals

Solve:

1. $3\frac{1}{2}$ $2\frac{5}{6}$ $6\frac{1}{4}$ (22)

2. $7\frac{2}{3}$ $-4\frac{5}{6}$ (25)

3. $61{,}437$ $-9{,}685$ (8)

4. 870 $\times 80$ (11)

5. 6.7 $\times 3.5$ (55)

6. $2\frac{1}{2} \times 3\frac{1}{4} =$ (29)

7. $1\frac{1}{3} \div \frac{3}{4} =$ (34)

8. $6\frac{1}{2} \times \frac{7}{8} \times 3\frac{1}{3} =$ (29)

9. $1.5\overline{)6}$ (69)

10. $8\overline{)28}$ (71)

11. $.34\overline{)1.7}$ (71)

12. $6 \div 1\frac{1}{2} =$ (34)

13. $100 \times 7.45 =$ (57)

14. $1 \div .001 =$ (71)

15. $\frac{4}{5}$ of $360 =$ (29)

16. 75% of $90 =$ (92)

17. 2.8% of $140 =$ (92)

18. $\frac{1}{2}\%$ of $1240 =$ (102)

19. $36 = ?\%$ of 720 (98)

20. $6 = 40\%$ of $?$ (108)

If you did not understand how to solve an example, turn to the page number in parentheses where you will find the step explained.

★For Those Who Made No Errors on the Above Test

It is possible to multiply two numbers by doubling one number and halving the other number and continuing this process as shown in the work on the right.

To multiply 35 by 43, write the two numbers as shown. Now divide 35 by 2 and write the quotient, 17, under 35. Drop all remainders. Now divide 17 by 2 and continue the halving process as shown. Multiply 43 by 2 and continue the doubling process as shown in column B.

A	B
35	43✓
17	86✓
8	172
4	344
2	688
1	1376✓

The product of 35 and 43 is the sum of the numbers in column B opposite odd numbers in column A. The numbers checked are opposite the odd numbers. Find the sum of 43, 86, and 1376. Check by multiplication.

Use the method shown to find: 27×46; 36×58.

Test in Problem Solving

Solve the following problems. If you are unable to solve a problem, turn for help to the page indicated on the right.

1. The value of the 2 in 24 is how many times the value of the 2 in .42? (44)

2. Jack is $68\frac{3}{8}$ inches tall. To the nearest half inch, what is his height? (5)

3. If 540 million dollars are spent in one year for housing, how many houses can be built at an average cost of $6000 a house? (16)

4. How many meters are there in 7.25 kilometers? (78)

5. A kilometer is approximately equal to $\frac{5}{8}$ mile. A speed of 50 m.p.h. is equal to about how many kilometers per hour? (79)

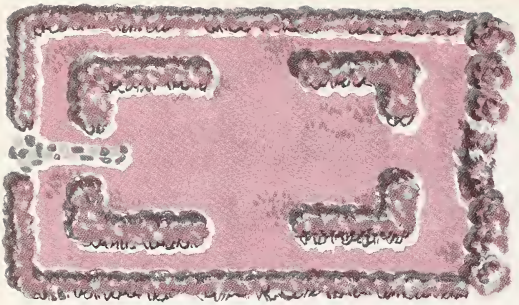
6. An airplane flew 420 miles in $1\frac{3}{4}$ hours. What was the average number of miles flown per hour? (34)

7. A basketball coach said, "I expect my team to make baskets on about 30% of its shots." At that rate, how many shots should be successful if the team had 88 shots at the basket in a game? (Answer to the nearest whole number.) (92)

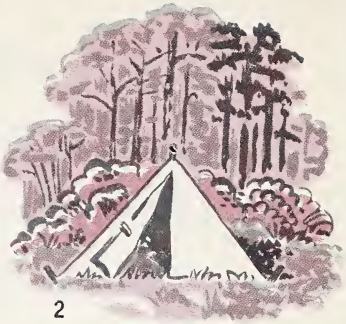
8. A test contains 40 items. If each item is given the same score and is marked in per cent, what per cent should one item count? (98)

9. A train fare at a special rate was $19.50. This was 60% of the regular fare. What was the regular fare? (108)

10. How much more is one discount of 25% on goods listed at $820 than successive discounts of 15% and 10%? (120)



1



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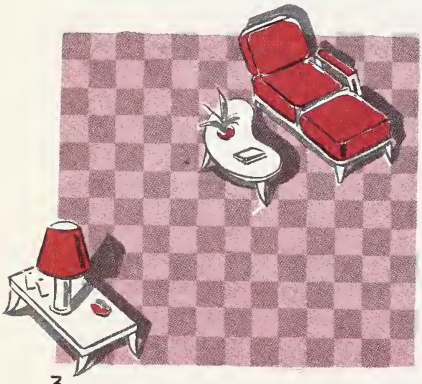

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4

5

6

CHAPTER IV

More about Formulas

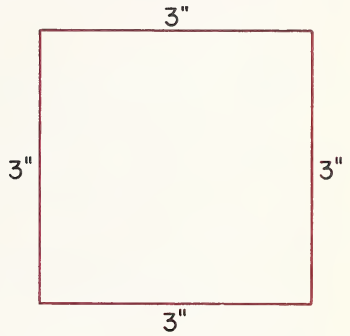
The pictures on page 126 illustrate **plane figures** with which you are familiar. A plane figure is one which has only length and width. We shall continue our study of formulas dealing with these figures.

1. Write on your paper the numbers of the illustrations on page 126 which show each of the following figures:

a. Circle	c. Rectangle	e. Trapezoid
b. Parallelogram	d. Square	f. Triangle

2. How may a rectangle differ from a square?

3. Find the perimeter of the square on the right by addition; by multiplication.



4. Write a rule for finding the perimeter of a square.

A **formula** is a short statement of a general rule. In a formula, usually the first letter of a word in a rule represents the word.

5. The formula for the perimeter of a square is:

p = 1s + 1s + 1s + 1s, or p = 4s. (4s means 4 times s.)

Tell what **p** represents; what **s** represents. (1s and **s** have the same value. We read it "**s**" and it means "one **s**."

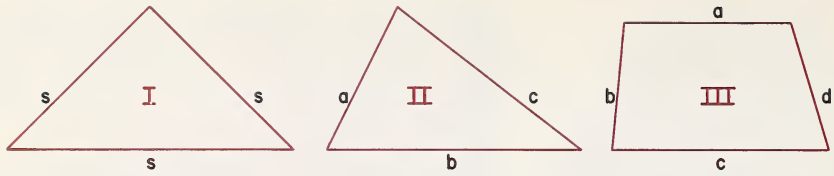
6. Find the perimeter of squares, each having a side of:

a. 6 ft.	c. $4\frac{1}{2}$ yd.	e. 76 cm.	g. 8.4 ft.	i. 5.7 mi.
b. 8 in.	d. $\frac{3}{4}$ mi.	f. 4.3 m.	h. 3.75 in.	j. 13.6 km.

7. If the perimeter of a square is 20 inches, what is the side of the square? (20 ÷ 4 = ?)

8. Find the side of squares each having a perimeter of:

a. 32 ft. b. 9 yd. c. 52 cm. d. $6\frac{1}{2}$ yd. e. 1.8



Finding Perimeters of Figures

The perimeter of a plane surface enclosed by straight lines is equal to the sum of the lengths of its sides.

1. Show that the formula for the perimeter of triangle I is $\mathbf{p} = 3\mathbf{s}$. Find **p** when **s** is equal to: 4 ft.; $6\frac{1}{2}$ in.; 18 cm.

2. The formula for the perimeter of triangle II which has sides of **a**, **b**, and **c**, is $\mathbf{p} = \mathbf{a} + \mathbf{b} + \mathbf{c}$. If $\mathbf{a} = 4$, $\mathbf{b} = 5$, and $\mathbf{c} = 7$, we find **p** by **substituting** 4 for **a**, 5 for **b**, and 7 for **c**, and then by adding those numbers. Find **p**.

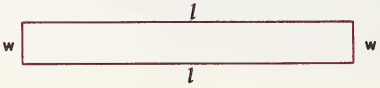
3. Use the formula in problem 2 and find the perimeter when $\mathbf{a} = 14$, $\mathbf{b} = 9$, and $\mathbf{c} = 10$; when $\mathbf{a} = 4.5$, $\mathbf{b} = 3.7$, and $\mathbf{c} = 5.8$.

4. Write the formula for the perimeter of figure III above.

5. Use the formula in problem 4 and find the perimeter when $\mathbf{a} = 6$, $\mathbf{b} = 8$, $\mathbf{c} = 12$, and $\mathbf{d} = 6$; when $\mathbf{a} = 7.5$, $\mathbf{b} = 8.4$, $\mathbf{c} = 10.8$, and $\mathbf{d} = 5.9$.

The formula for the perimeter of a rectangle is

$$\mathbf{p} = l + \mathbf{w} + l + \mathbf{w}$$
or $$\mathbf{p} = 2l + 2\mathbf{w}$$
or $$\mathbf{p} = 2(l + \mathbf{w})$$



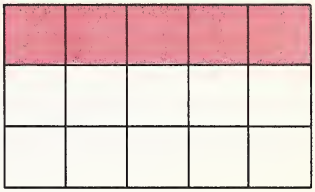
Whenever parentheses are used, it means that the numbers inside them are to be worked with first. The parentheses here show that the sum of the values of the letters within them is to be found and then multiplied by 2.

6. Find the perimeter of a rectangle 8 feet long and 5 feet wide.

Substitute 8 for l and 5 for **w** in the formula $\mathbf{p} = l + \mathbf{w} + l + \mathbf{w}$ and show that this answer is the same as that obtained by using the formula $\mathbf{p} = 2(l + \mathbf{w})$.

$$\mathbf{p} = 2(l + \mathbf{w})$$
$$\mathbf{p} = 2(8 + 5) = 2 \times 13 = ?$$

The Formula for the Area of a Rectangle



1. How many squares are there in one row of the rectangle on the right? How many rows? How many squares in all?

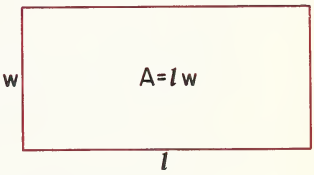
2. Write a rule for finding the number of square units in a rectangle.

3. If each square represents a square foot, what is the area of the rectangle shown above?

4. If each square represents a square centimeter, what is the area of the rectangle?

Area means the number of square units a surface contains.

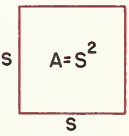
5. What is the formula for the area of a rectangle?



6. Substitute numbers for letters to show that lw has the same value as wl. What is the area of a rectangle 9 feet long and 7 feet wide?

7. What is the formula for the area of a square?

The ^{2} written above the **s** in the formula is called an **exponent**. The exponent ^{2} in this case means that **s** is to be multiplied by itself, or $s \times s$.



8. A certain square has a side of 8 inches. Show that the area of this square may be found by using the formula $A = lw$.

9. Find the area of a square having a side of 15 in.; of 4.7 ft.; of 28 cm.; of $3\frac{1}{2}$ ft.

10. Find the perimeter of each square in problem 9.

11. The perimeter of a figure is always expressed in what kind of unit of measure?

12. The area of a figure is always expressed in what kind of unit of measure?

★13. Nellie said, "In a square having a side of 4, the perimeter and the area are the same." Was she correct?

Finding Perimeters and Areas of Rectangles

The table below gives the dimensions of certain rectangles. Find the missing numbers. (l = length; w = width; p = perimeter; A = area).

	l	w	p	A		l	w	p	A
1.	14 ft.	9 ft.	?	?	6.	36 cm.	24 cm.	?	?
2.	27 in.	16 in.	?	?	7.	9.5 m.	4.8 m.	?	?
3.	9.5 ft.	9.5 ft.	?	?	8.	4.6 km.	3.5 km.	?	?
4.	$1\frac{1}{4}$ mi.	$\frac{3}{4}$ mi.	?	?	9.	7.4 cm.	5.5 cm.	?	?
5.	$8\frac{1}{2}$ in.	$5\frac{1}{4}$ in.	?	?	10.	25 cm.	25 cm.	?	?

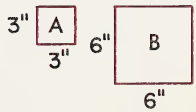
11. Express the perimeter in problem 10 in two other kinds of metric units.

12. A rug 9′ × 12′ (9 ft. by 12 ft.) is on the floor of a room 10′ × 15′. How many square feet of the floor space are not covered?

13. The rug in problem 12 covers what per cent of the area of the floor?

14. The greatest size an official playing court for basketball may be is 50′ × 94′ and the smallest size, 35′ × 60′. How much greater is the area of the court of largest size than that of smallest size?

15. A side of square B is how many times as long as a side of square A?



16. What is the perimeter of square A? What is the perimeter of square B?

17. From problem 16, you found that doubling the side of a square multiplies the perimeter of the square by what number? Test your answer with three other pairs of like squares.

18. What is the area of square A? What is the area of square B?

★19. From problem 18, you found that doubling the side of a square multiplies the area of the square by what number?

★20. Doubling both the length and the width of a rectangle multiplies the area of the rectangle by what number?

★21. What is the effect on the area of a rectangle if the length is doubled and the width is halved?

MORE PRACTICE

Proper Lighting Is Essential

Authorities on school buildings agree that the total area of the windows of a properly lighted classroom must be at least 20% of the area of the floor of the room.

1. A classroom is 21 feet wide and 29 feet long. To the nearest square foot, what should be the least number of square feet of window space that would meet the minimum lighting requirements?

2. The window space in each of the following classrooms is how much more or how much less than 20% of the floor space?

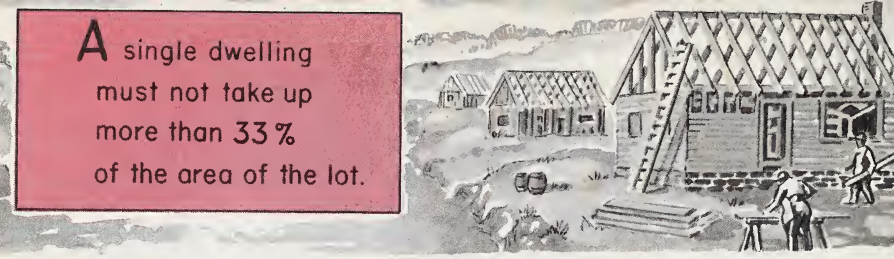
	Dimensions of Room	Number of Windows	Size of Windows		Dimensions of Room	Number of Windows	Size of Windows
a.	21′×32′	5	3′×7′	c.	19′×22.5′	4	3′×7.5′
b.	21′×35′	5	4′×7.5′	d.	24′×38.5′	6	4′×7.5′

3. How many square feet are there in a square yard? If you forget, how can you figure it out?

4. Health authorities agree that all playgrounds should be treated twice a year with $\frac{1}{4}$ gallon of disinfectant per square yard of surface. If treated twice a year, find the number of gallons needed to treat playgrounds each having the following dimensions:

a. 150′ × 375′ b. 300′ × 675′ c. 450′ × 725′ d. 250′ × 500′

★5. The area of a certain playground is an acre (43,560 sq. ft.). About how many gallons of disinfectant are needed to treat the playground if $\frac{1}{4}$ gallon is used per square yard?



Property Standards

The N.H.A. (National Housing Act) will guarantee that a loan on a house made at a bank will be repaid if both the size of the house and the lot on which it is to be built meet certain standards.

1. According to standards set by N.H.A., find the greatest areas that houses may occupy on rectangular lots having the following dimensions:

a. $40' \times 75'$	c. $35' \times 80'$	e. $40' \times 60'$
b. $50' \times 75'$	d. $50' \times 100'$	f. $45' \times 100'$

2. Mr. Green wishes to build a house $24' \times 32'$. According to standards set by N.H.A., on which of the lots in problem 1 would he be permitted to build the house?

3. The area of the windows of a living room in a house which meets the standards of N.H.A. must not be less than 10% of the area of the floor. Find the least amount of area of the windows allowable in living rooms having the following dimensions:

a. $12' \times 15'$	c. $9' \times 14'$	e. $12' \times 18'$
b. $14' \times 18'$	d. $15' \times 21'$	f. $8\frac{1}{2}' \times 14'$

4. A living room is $12' \times 20'$. If the room contains two windows, each of which is 30 inches wide and 5 feet high, their area is what per cent of the area of the floor? Does this room have enough window space to meet the standards of N.H.A.

5. A house which meets N.H.A. standards must have at least one bathroom and either three rooms of specified size or one room for every $1\frac{1}{2}$ persons. Using this rate, find the number of rooms needed for a family of 3; for a family of 4; for a family of 6.

Snow Tests a House Roof

The roof of a house in a part of this country which may have a heavy snowfall must be strong enough to withstand the weight of the snow which collects on the roof. In some cities in this country, building standards demand that the roof must be able to support a weight of at least 40 pounds per square foot as a safety measure. The Weather Bureau figures that 10 inches of snow when melted is equal to 1 inch of water. Water 1 inch deep on each square foot of surface weighs 5.2 pounds.

1. Find the number of inches of water snow will make, when melted, if the depth of the snow is 4 in.; 9.5 in.; 14 in.; 21.6 in.

2. To the nearest 0.1 pound, find the weight of the snow on a square foot of surface when the depth of the snow is 5 in.; 3.5 in.; 1 ft.; 18 in.; 22.5 in.

3. To the nearest 100 pounds, find the weight of snow on each roof when the size of the roof and the depth of the snow are:

Size of Roof	Depth of Snow	Size of Roof	Depth of Snow
a. 25′ × 36′	7 in.	**d.** 40′ × 80′	1 ft.
b. 18′ × 25′	4 in.	**e.** 60′ × 110′	3.5 in.
c. 35′ × 48′	2 in.	**f.** 80′ × 350′	6.4 in.

★**4.** In problem **3**, express in tons the weight of the snow.

★**5.** If you live in a part of the country which has snowfalls, estimate the number of square feet in the area of the roof of some building. Then find the number of tons in the weight of the snow on this surface when the depth of the snow is 6 inches.

Conservation of Our Forests

The Canadian Department of Agriculture has discovered that many trees which ordinarily would be killed by blight and insects may be preserved by spraying. The table below gives some facts about the use of airplanes for spraying our forests.

Airplane	Speed	Spray Load	Spray Used per Minute
A	90 m.p.h.	400 gal.	54 gal.
B	90 m.p.h.	300 gal.	36 gal.
C	84 m.p.h.	150 gal.	32 gal.
D	135 m.p.h.	1000 gal.	112 gal.

1. How many miles does each airplane listed fly in a minute?

2. If the airplanes in the table are loaded with spray solution, how many minutes will it take each one to use its load? Give the answer to the nearest tenth of a minute.

3. If an airplane flies in a straight line and sprays a strip of land 200 feet wide and a mile long, what would be the shape of the surface sprayed? How many square feet would there be in the area?

★4. An airplane sprays a strip of land $\frac{1}{16}$ of a mile wide when flying at a speed of 90 m.p.h. Find what part of a square mile the airplane sprays in 6 min.; in 10 min.; in 4 min.

Comparing Different Units of Measure

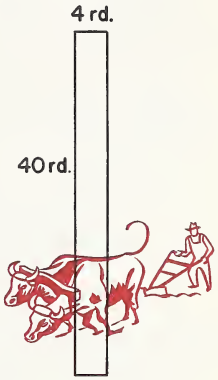
1. How many square inches are there in a square foot?

2. How many square feet are there in a square yard?

3. There are $16\frac{1}{2}$ feet in a rod. How many yards are there in a rod?

4. From the data in problem 3, tell how many square feet there are in a square rod. How many square yards are there in a square rod?

5. Originally an acre was the shape of the strip of land shown on the right. How many square rods are there in an acre?



6. In problem 5, express the dimensions in feet.

7. Prove that there are 43,560 square feet in an acre.

8. Prove that an acre is approximately equal to the area of a square having a side of 209 feet.

9. There are $16\frac{1}{2}$ feet in a rod. How many rods are there in a mile?

10. Show that there are 640 acres in a square mile. $\frac{320 \times 320}{160}$

11. A square mile is called a **section**. How many acres are there in a farm which contains $\frac{1}{4}$ section? $1\frac{1}{2}$ sections?

12. Some provinces are divided into **townships**. A township may be a square 6 miles on a side. A township is equal to how many square miles? to how many sections? to how many acres?

★13. How may an area of one square mile be different from an area one mile square? Make a drawing to show the difference.

★14. If the posts of a fence enclosing a rectangular field are set 1 rod apart, how would it be possible to estimate the number of acres in the field by counting the number of posts along the width and length of the field?

A Cement or an Asphalt Highway?

A Highway Commission studied construction and maintenance costs of highways made of cement and of asphalt. The following problems are based on the findings of the study.

1. The average life of a cement highway is 28 years and that of an asphalt highway is 13.5 years. The life of a cement highway is approximately how many times the life of an asphalt highway?

2. The original cost per square yard to build a highway of cement was \$6.50 and of asphalt, \$5.

a. Find the number of square yards there are in a road 1 mile long when the width is 18 ft.; when the width is 24 ft.

b. Find the cost of constructing a mile of cement highway when the width is 18 ft.; when the width is 24 ft.

c. Find the cost of constructing a mile of asphalt highway when the width is 18 ft.; when the width is 24 ft.

3. At the rates given in problem 2, how much more would it cost to build a highway 1 mile long and 30 feet wide with cement than with asphalt?

4. The cost of maintaining a square yard of cement highway is 1.4¢ per year, and $\frac{3}{8}$¢ per year for a square yard of asphalt highway. Find the yearly cost to maintain a cement highway a mile long and 30 feet wide; the cost to maintain an asphalt highway of the same size.

★ 5. From the data in problems 2 and 4, find the cost of constructing a cement highway 5 miles long and 18 feet wide and then maintaining it for a period of 10 years at the rates given.

★ 6. Find the total cost of construction and maintenance of an asphalt highway which is the same size as the cement highway in problem 5.

Practise What You Have Learned

1. $.936 + .877 + .058 + .760 + .495$

2. $74{,}346 - 9{,}458$

3. 980×870

4. $76 \times 5\frac{3}{8}$

5. $9\frac{1}{4} - 7\frac{2}{3}$

6. $17\overline{)86142}$

7. $380\overline{)96376}$

8. $1.6\overline{).12}$

9. $\frac{3}{4} \times 7\frac{1}{2} =$

10. $1\frac{1}{2} \times 2\frac{1}{4} \times 3\frac{1}{7} =$

11. $\frac{5}{6} \div \frac{3}{8} =$

12. $100 \times 3.75 =$

13. $9 \div .03 =$

14. $\frac{5}{8}$ to nearest 0.1 =

15. $\frac{1}{2}\%$ of 760 =

16. 150% of 468 =

17. 300% of 27 =

18. 5 = ?% of 4

19. 36 = ?% of 25

20. 1.8 = ?% of 18

21. 10 = 5% of ?

22. 150% of ? = 60

23. 400 = 20% of ?

Number Quickies

1. A millimeter is what per cent of a centimeter?

2. A centimeter is what per cent of a meter?

3. What per cent of a kilometer is 10 meters?

4. A section of land is what per cent of a square mile of land?

5. In a recent year 1.1% of the steel produced in this country was used in road construction. If 3.6 million tons of steel were produced, how many tons were used in road construction?

6. In a recent year the goal for raising funds for the March of Dimes was half a billion dimes. If this goal had been reached, how many dollars would have been collected?

7. When a car travels 11 miles in 12 minutes, what is its speed in miles per hour?

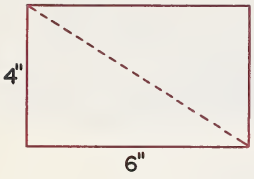
8. An airplane has a speed of 300 m.p.h. How many seconds does it take to travel a mile at this speed?

9. How many $10,000-bills does it take to make a million dollars?

10. In a number, what is the value of a 3 written six places to the left of ones' place?

11. The value of the 4 in 405 is how many times the value of the 2 in .25?

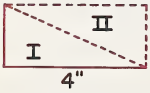
Learn by Doing: Triangles



1. What is the area of the rectangle shown on the left?

2. Draw a rectangle like the one shown and cut it along the diagonal, as indicated. Show that the two triangles are equal.

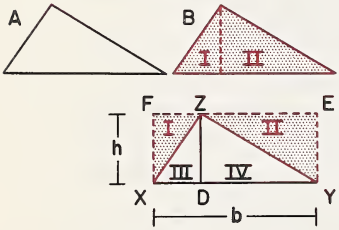
3. The area of each of the triangles is what per cent of the area of the rectangle?



4. What is the area of triangle I on the left?

5. If triangle II is placed in the position shown, what kind of figure do the two triangles form? What is the area of this figure?

Not all triangles have the shape of triangles I and II. Let us discover how to find the area of any triangle.



6. From paper of different colors cut two triangles of the same shape and size as triangles A and B. Then cut one of the triangles along the **altitude** as shown in B so as to form triangles I and II.

7. Place triangles I and II upon the other triangle (XYZ) as shown. Which triangle is equal to triangle I? Which triangle is equal to triangle II?

8. What kind of figure is XYEF? The area of the triangle XYZ is what part of the area of the rectangle XYEF?

9. The side XY of the rectangle is the base of the triangle XYZ. What letter represents this side?

10. The side XF of the rectangle is equal to the altitude or height of the triangle. What letter represents this height?

11. The formula for finding the area of any triangle is

$$A = \tfrac{1}{2}\,bh \quad \text{or} \quad A = \tfrac{1}{2}\,ab$$

We may represent the altitude of a triangle by the letter **h** or **a**. Show that the formula represents the rule you made in problem 8. State what each letter means.

Finding the Area of a Triangle

1. The base of the triangular sail for the boat shown is 8 feet long and the height of the sail is 10 feet. What is the area of the sail?

$b = 8$ $\qquad$ $A = \frac{1}{2}bh$, the formula
$h = 10$ $\qquad$ $A = \frac{1}{2} \times 8 \times 10$

$A = ?$ $\qquad$ $A = \frac{8 \times 10}{2} = \frac{80}{2} = 40$

The area of the sail is 40 square feet.

Find the areas of triangles having the following dimensions:

	Base	Altitude		Base	Altitude
2.	9 ft.	7 ft.	7.	9.4 ft.	3.8 ft.
3.	16 in.	21 in.	8.	$\frac{1}{2}$ mi.	$\frac{1}{4}$ mi.
4.	36 cm.	28 cm.	9.	72 cm.	120 cm.
5.	$6\frac{1}{2}$ ft.	$9\frac{1}{2}$ ft.	10.	.6 m.	.5 m.
6.	7 yd.	$4\frac{1}{3}$ yd.	11.	4.8 cm.	3.5 cm.

12. Substitute numbers for base and altitude in the formula for the area of a triangle to show that each of the following methods may be used to find the area of a triangle:

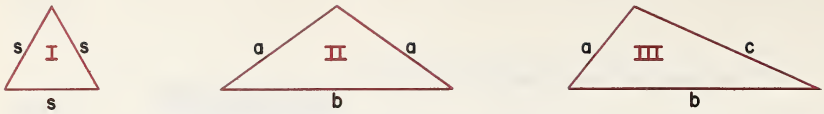
a. One half the altitude times the base.
b. One half the base times the altitude.
c. One half the product of the base and the altitude.

13. Find each of the following products:

a. $\frac{1}{2} \times 8 \times 7$ $\qquad$ b. $\frac{1}{2} \times 7 \times 12$ $\qquad$ c. $\frac{1}{2} \times 9 \times 13$

★14. Use problems 12 and 13 to show that the following rule is true for finding half of the product of two numbers:

We may take half of either number and multiply it by the other number, or we may take half of the product of the two numbers, but we may not take the product of half of each of the numbers.



Kinds of Triangles According to Sides

In each of the triangles above, the sides that are equal are indicated by the same letter.

1. How many sides in triangle I are equal?

A triangle in which all sides are equal is an **equilateral triangle.**

2. How many sides in triangle II are equal?

A triangle in which two sides are equal is an **isosceles triangle.**

3. How many sides in triangle III are equal?

A triangle in which no sides are equal is a **scalene triangle.**

4. We can write the formula for the perimeter of an equilateral triangle having a side **s**, as $\mathbf{p} = 1\mathbf{s} + 1\mathbf{s} + 1\mathbf{s}$. Hence, $\mathbf{p} = ?$

5. Use the formula for the perimeter of an equilateral triangle and find **p** when **s** is equal to: 7 in.; 9 ft.; 18 cm.; 3.8 m.

6. Show that the formula for the perimeter of the isosceles triangle given above is $\mathbf{p} = 2\mathbf{a} + \mathbf{b}$.

7. Find **p** in the formula of problem 6 when $\mathbf{a} = 7$ in. and $\mathbf{b} = 8$ in.; when $\mathbf{a} = 6\frac{1}{4}$ ft. and $\mathbf{b} = 9$ ft.; when $\mathbf{a} = 25$ cm. and $\mathbf{b} = 18$ cm.

8. Write the formula for the perimeter of any scalene triangle, as triangle III. Find **p** when $\mathbf{a} = 9$, $\mathbf{b} = 7$, and $\mathbf{c} = 15$; when $\mathbf{a} = 8.6$, $\mathbf{b} = 9.5$, and $\mathbf{c} = 10.4$; when $\mathbf{a} = 36$, $\mathbf{b} = 54$, and $\mathbf{c} = 28$.

9. Doubling the side of an equilateral triangle has what effect on its perimeter?

★10. Give illustrations to show which of the following statements are true and which are false:

a. An equilateral triangle is also an isosceles triangle.

b. An isosceles triangle is also an equilateral triangle.

c. The base of an isoceles triangle must always be less than one of the equal sides.

d. The altitude of a triangle is always longer than the base of the triangle.

A

B

C

D

Kinds of Triangles According to Angles

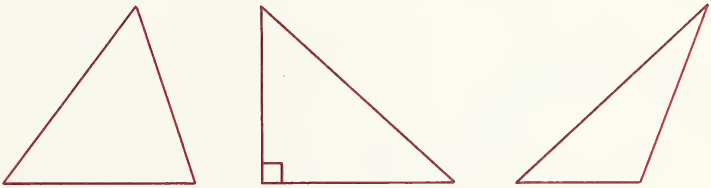
The names of the four familiar kinds of angles are **acute angle**, **right angle**, **obtuse angle**, and **straight angle**.

1. A right angle contains how many degrees? On which clock do the hands form a right angle?

2. An acute angle is less than 90°. On which clock do the hands form an acute angle?

3. An obtuse angle is greater than 90°, but less than 180°. On which clock do the hands form an obtuse angle?

4. A straight angle is an angle which has its sides extending in opposite directions to form a straight line. There are 180° in a straight angle. On which clock do the hands form a straight angle?

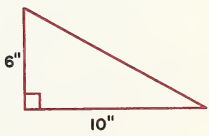

A B C

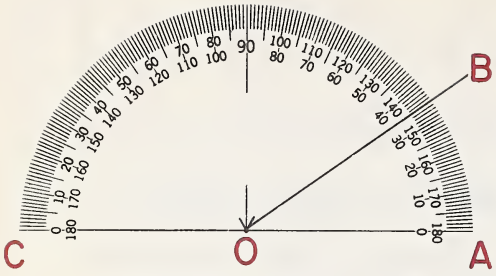
5. A triangle which contains a right angle is called a **right triangle**. Which triangle shown above is a right triangle?

6. A triangle, all of whose angles are acute, is called an **acute triangle**. Which triangle shown above is an acute triangle?

7. A triangle, one of whose angles is an obtuse triangle, is called an **obtuse triangle**. Which triangle shown above is an obtuse triangle?

★8. What is the area of the triangle on the right? Why is the area of a right triangle equal to half the product of the two sides which form the right angle?





Using a Protractor

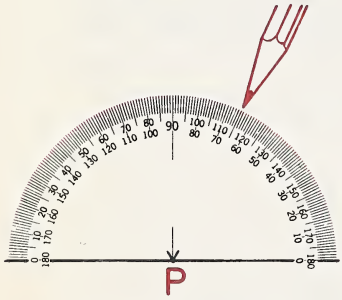
We measure the number of degrees in an angle with a **protractor.** The illustration shows a protractor.

1. How many degrees are there in angle AOB? How many degrees in angle COB? What is the sum of the number of degrees in these two angles?

2. What is the sum of each set of two numbers shown at the numbered points on the scale of the protractor?

3. The **outer scale** is the scale farther from the center. Does this scale begin at A or at C? At which of the two points does the **inner scale** begin? How is the center point indicated?

4. Draw an angle of 65°.



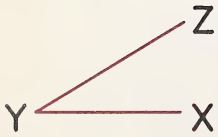
First, draw a line and mark a point on it, as P. Then place the arrowhead of the protractor at P and have one arm of the protractor fall along this line. From the zero point on the scale of the protractor, find 65° on the same scale and mark this point on your paper. Connect the point you marked with the point at P. How do you know which is the 65° angle?

5. Use your protractor to draw each of the following angles:

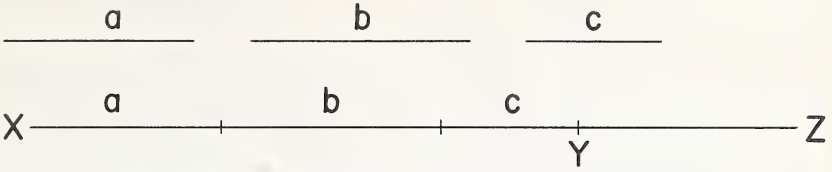
a. 75° b. 43° c. 115° d. 158° e. 94°

Label each angle by writing its measure within it.

★6. Measure the number of degrees in angle XYZ.



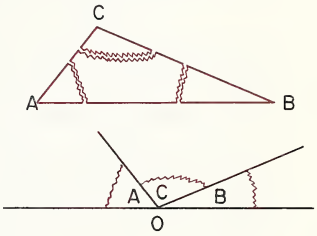
Place the arrowhead of the protractor at Y and have one arm of the protractor fall along XY. Use the inner scale and then read the number at the point at which the side YZ of the angle cuts this scale of the protractor. XYZ = ? degrees?



The Angles of a Triangle

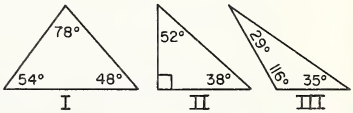
1. Find the sum of lines **a**, **b**, and **c**. Draw any line XZ. On it mark off a distance equal to line **a**, then a distance equal to line **b**, and then a distance equal to line **c**. The line XY is equal to the sum of these three lines. If **a** = $1\frac{1}{2}$ in., **b** = $1\frac{1}{4}$ in., and **c** = $\frac{7}{8}$ in., what is the length of XY?

2. From paper, cut a triangle and letter the angles at each **vertex**, A, B, and C, as shown. Then tear off part of the triangle at each vertex. Place the pieces as shown on the right. What is the sum of the angles at O?



3. Find the sum of the angles of triangle I; of triangle II; of triangle III.

4. What kind of triangle is triangle I? What kind is triangle II? What kind is triangle III?



5. Draw a right triangle, an obtuse triangle, and an acute triangle. Measure the number of degrees in each angle of these triangles with your protractor. Find the sum of the number of degrees in each triangle. Is each sum approximately equal to 180°?

The answers in problems 2, 3, and 5 should help you see that **the sum of the angles of a triangle is equal to 180°.** How does this fact help you find the size of the third angle of a triangle if the size of two of the angles is known?

6. If angles A, B, and C are the angles of a triangle, find the missing angle in each of the following: Angle A = 47°, Angle B = 56°, Angle C = ?; Angle A = ?, Angle B = 106°, Angle C = 39°; Angle A = 75°, Angle B = ?, Angle C = 58°.

MORE PRACTICE

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Canada's Parks Attract Many Visitors

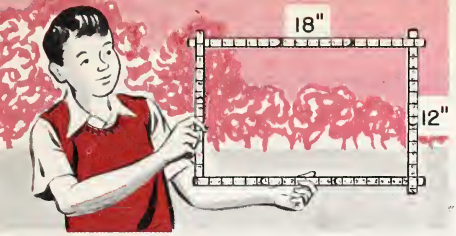
1. In a recent year 1,950,000 people visited Canada's National Parks. Of these, 24 per cent came from the United States. How many Americans visited the Parks?

2. The total area of the National Parks is 29,000 square miles. Three of the largest Parks are Prince Albert, Saskatchewan, 1496 square miles, Banff, Alberta, 2564 square miles, and Jasper, Alberta, 4200 square miles. Express each of these areas as a percentage of the total Park area.

3. Besides the National Parks, six of the ten provinces have established Provincial Parks. The table below shows the areas of the Park lands and the total areas of these six provinces. Find the total park area and the total area of these provinces.

Province	Square Miles Park Area	Square Miles Total Area
British Columbia	14,071	359,279
Quebec	9,834	523,860
Ontario	6,177	363,282
Saskatchewan	1,685	237,975
Newfoundland	42	147,994
Alberta	13	248,800
Totals		

4. What percent of the total area of these six Provinces is the total Park area?



Learn by Doing: Area of a Parallelogram

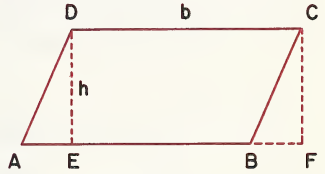
1. Ted opened a carpenter's rule to form the left-hand figure. What kind of figure did he make? What are the dimensions of this figure? What is its area?

2. Ted applied pressure along one side of the rectangle and made the right-hand figure above. Name this figure.

3. Use the illustration above to show that the opposite sides of a parallelogram are equal.

In a parallelogram, the opposite sides are equal and parallel.

4. From paper, cut a parallelogram, such as ABCD. Then cut the right triangle AED and place it in the position of BFC. What kind of figure is formed by EFCD? What is its area?



5. The parallelogram ABCD has the same base as the rectangle EFCD. The altitude of the parallelogram is DE. This distance, DE, is the same as which dimension of the rectangle? Which dimensions are used in finding the area of a rectangle? How are these dimensions related to parts of a parallelogram?

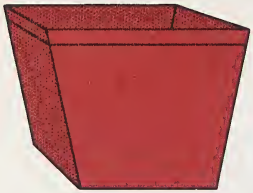
6. The formula for finding the area of a parallelogram is:

$$A = bh$$

Tell what the **A** represents; the **b**; the **h**.

Find the areas of parallelograms having the following dimensions:

	Base	Altitude		Base	Altitude		Base	Altitude
7.	9 ft.	4.6 ft.	9.	38 cm.	45 cm.	11.	3 yd.	$1\frac{1}{4}$ yd.
8.	$7\frac{1}{2}$ in.	16 in.	10.	.6 m.	1.4 m.	12.	$4\frac{1}{2}$ ft.	$2\frac{3}{4}$ ft.

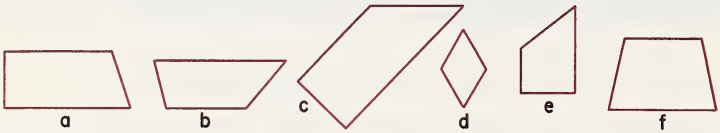


Learn by Doing: Trapezoids

1. How many of the edges of the face of the waste paper basket are parallel? How many are not parallel?

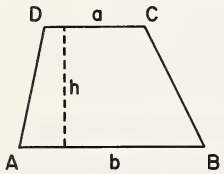
2. What name is given to a figure having the shape of a face of the waste paper basket shown?

A **trapezoid** is a figure of four sides which has two and **only** two sides parallel.

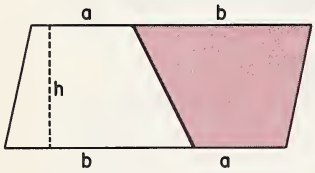


3. Which one of the figures given above is not a trapezoid?

4. In a trapezoid the parallel sides are unequal in length. If the two parallel sides of a figure of four sides are equal, what kind of figure is formed? How do you know?



5. From paper, cut two equal trapezoids, such as ABCD. Mark each upper parallel side **a** for the **upper base** and mark each lower parallel side **b** for the **lower base**. The distance between the parallel sides is the altitude of the trapezoid. What letter represents the altitude of the given trapezoid?



6. Now place the two trapezoids you cut out in the position shown on the left. What kind of figure is formed? What is the altitude of this figure?

7. Show that the base of the parallelogram is equal to the sum of the upper base and the lower base of the trapezoid, or $\mathbf{a} + \mathbf{b}$.

8. If the base is $\mathbf{a} + \mathbf{b}$ and the altitude is **h**, show that the area of the parallelogram is equal to $\mathbf{h}(\mathbf{a} + \mathbf{b})$.

9. Since the trapezoid is equal to half the parallelogram, what is the area of the trapezoid? Write the formula.

The Formula for Finding the Area of a Trapezoid

On page 146 we proved the following:

The area of a trapezoid is equal to half the product of the altitude and the sum of the two bases.

The formula for finding the area of a trapezoid is

$$A = \tfrac{1}{2} h \times (a + b) \text{ or } A = \tfrac{1}{2} h\,(a + b)$$

1. In the above formula, tell what the **A** represents; the **h**; the **a**; the **b**.

2. Find the area of a trapezoid having an altitude of 8 inches, if one base is 6 inches and the other base is 10 inches.

$h = 8$
$a = 6$
$b = 10$
$A = ?$

$A = \tfrac{1}{2} h\,(a + b)$, the formula
$A = \tfrac{1}{2} \times 8\,(6 + 10)$

The parentheses show that the numbers within, 6 and 10, are to be added first and then the sum is to be multiplied by half the altitude.

$$A = \tfrac{1}{2} \times 8 \times 16 = \frac{8 \times 16}{2} = 64$$

The area is 64 square inches.

Find the areas of trapezoids having the following dimensions:

	Altitude	Upper Base	Lower Base		Altitude	Upper Base	Lower Base
3.	4 ft.	9 ft.	14 ft.	6.	$1\frac{1}{2}$ ft.	5 ft.	8 ft.
4.	6 in.	15 in.	7 in.	7.	7.5 in.	9 in.	4 in.
5.	24 cm.	36 cm.	45 cm.	8.	.4 m.	.7 m.	1.2 m.

★9. Substitute numbers to show that each of the following rules may be used to find the area of a trapezoid:

a. Half the altitude times the sum of the two bases.

b. Half the sum of the two bases times the altitude.

c. Half the product of the altitude and the sum of the two bases.

★10. In an **isosceles trapezoid** the two sides which are not parallel are equal. In problem 3 on page 146, which of the trapezoids is an isosceles trapezoid? Draw an isosceles trapezoid.

MORE PRACTICE

Practise What You Have Learned

1. $\begin{array}{r} 43{,}710 \\ -28{,}954 \end{array}$ 2. $\begin{array}{r} 976 \\ \times 407 \end{array}$ 3. $\begin{array}{r} 87\frac{1}{2} \\ \times 9 \end{array}$ 4. $\begin{array}{r} 6\frac{2}{3} \\ -5\frac{3}{4} \end{array}$ 5. $\begin{array}{r} 7.6 \\ \times 8.5 \end{array}$

6. $9\overline{)4112}$ 7. $16\overline{)81443}$ 8. $284\overline{)93745}$ 9. $1.5\overline{)12}$

10. $\frac{5}{6} \times 2\frac{3}{4} =$ 11. $72 \div \frac{3}{8} =$ 12. $\frac{4}{5}$ of 85 = 13. $\frac{3}{4} \div \frac{7}{8} =$

14. $7 \div .01 =$ 15. $.3\overline{).84}$ 16. $\frac{7}{8} =$?% 17. $\frac{5}{6} = \frac{?}{24}$

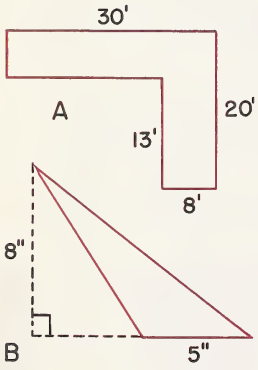
18. 15% of 96 = 19. 102% of 450 = 20. $\frac{1}{2}$% of 750 =

21. 7 = ?% of 21 22. 150 = ?% of 90 23. 11 = ?% of 11

24. 10 = 5% of ? 25. 30% of ? = 150 26. 60 = 150% of ?

27. Find the sum of the following numbers without recopying them: 736 + 429 + 1856 + 94 + 548

Finding Areas of Figures



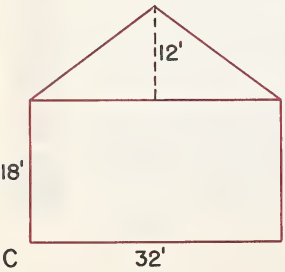
1. What is the perimeter of the surface represented by A? What is its area?

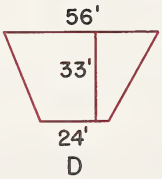
2. Find the area of the figure represented by B; by C; by D.

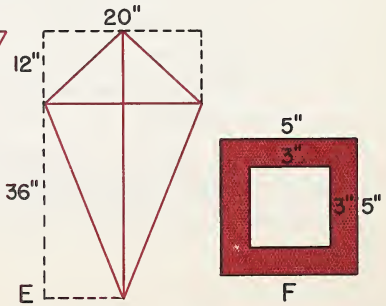
3. What is the length of the kite shown in E? What is its area?

4. What is the area represented by the shaded part of F?

5. The area represented by the small square in F is what per cent of the area represented by the large square?







The Formula for Finding the Circumference of a Circle

Nan marked a point on the tire of her bicycle and another point on the sidewalk where the first point touched it. Then she rolled the bicycle until the chalk mark on the tire touched the sidewalk again. Nan marked this point on the sidewalk. Then she measured the distance between the two chalk marks on the sidewalk and found it to be 88 inches.

1. The distance around the wheel or around a circle is the **circumference.** What is the circumference of a wheel on Nan's bicycle?

2. What is the diameter of a wheel shown?

3. Divide the circumference by the diameter. What is the quotient?

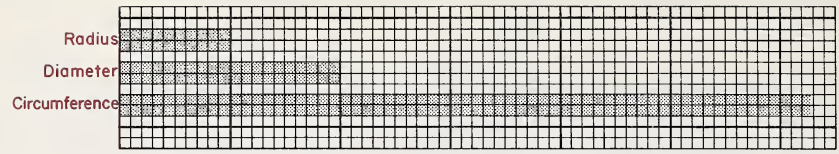
The ratio of the circumference to the diameter is expressed by the Greek letter π (pronounced pie). The exact value of π cannot be found. The value of π is equal to approximately $3\frac{1}{7}$, 3.14, or 3.1416. We shall use the value of π as equal to $3\frac{1}{7}$ or 3.14.

4. If the circumference of a circle is π times the diameter, the formula for finding the circumference may be expressed as $\pi \times \mathbf{d}$ or $\pi \times 2\mathbf{r}$.

Hence, $\mathbf{C} = \pi\mathbf{d}$ or $\mathbf{C} = 2\pi\mathbf{r}$

In the formula, tell what the **C** represents; the **d**; the **r**.

5. If a member of your class has a bicycle, use it to perform the experiment Nan made.



Finding the Circumference of a Circle

1. The graph shows a comparison in length of **radius** (**r**), **diameter** (**d**), and **circumference** (**c**). Each large square on the graph represents 1 inch.

a. What is the length of the radius? of the diameter?

b. Approximately what is the length of the circumference?

c. On ruled paper make a graph like the one above showing **r**, **d**, and **c**, when $\mathbf{r} = 2$ inches.

2. A circle has a diameter of 6 inches. What is its circumference?

$\pi = 3.14$	$\mathbf{C} = \pi\mathbf{d}$, the formula
$\mathbf{d} = 6$	$\mathbf{C} = 3.14 \times 6$
$\mathbf{C} = ?$	$\mathbf{C} = 18.84$

The circumference is approximately 18.84 inches.

3. What is the radius of the circle in problem 1?

Using the formula $\mathbf{C} = 2\pi\mathbf{r}$, show that the answer will be the same as that given in the illustration.

4. Using $\pi = 3.14$, find the circumference of each of the following circles when:

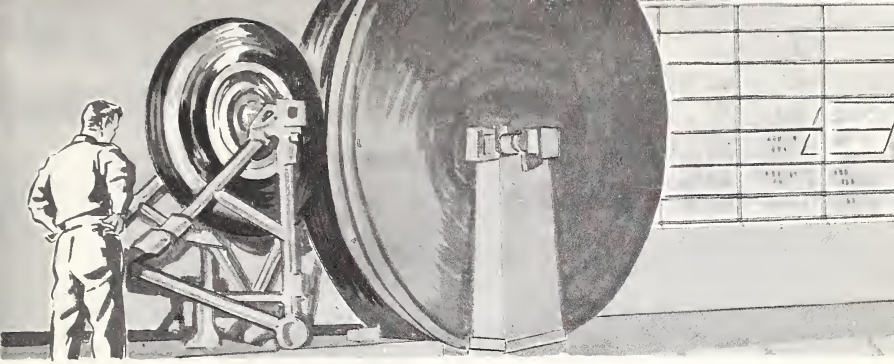
a. $\mathbf{d} = 5$ ft.	c. $\mathbf{d} = .5$ mi.	e. $\mathbf{r} = 8$ in.
b. $\mathbf{d} = 20$ cm.	d. $\mathbf{d} = 4.5$ in.	f. $\mathbf{r} = 25$ cm.

5. How many feet are there in the circumference of a wheel which has a diameter of 14 inches? (Use $\pi = 3\frac{1}{7}$)

6. A wheel has a circumference of $3\frac{1}{3}$ feet. How many revolutions will the wheel make in traveling a mile?

7. A grass plot within a circular running track has a diameter of 140 yards. What is the distance around the inside of the track? The distance is what part of a mile? (Use $\pi = 3\frac{1}{7}$)

8. If the diameter of the earth is 8000 miles, to the nearest 1000 miles, what is the length of the circumference? (Use $\pi = 3.14$)



Testing the Durability of an Automobile Tire

The picture shows how an automobile tire is tested to find the number of miles of service it will give on a car. The tire runs on a rotating steel wheel which is 10 feet in diameter. The wear on the tire is about the same as the wear that occurs when the tire is on a car travelling on a smooth surface, such as a concrete or asphalt highway.

1. How many feet are there in the circumference of the steel wheel shown above? ($\pi = 3.14$)

2. To the nearest whole number, how many revolutions will a wheel 31.4 feet in circumference make in travelling a mile?

3. If the diameter of an inflated tire is 28 inches, how many inches are there in the circumference? How many feet in the circumference? ($\pi = \frac{22}{7}$)

4. If the circumference of the large wheel is approximately $31\frac{1}{2}$ feet and the circumference of a tire is 7 feet, approximately how many revolutions will the tire make while the large wheel makes one revolution?

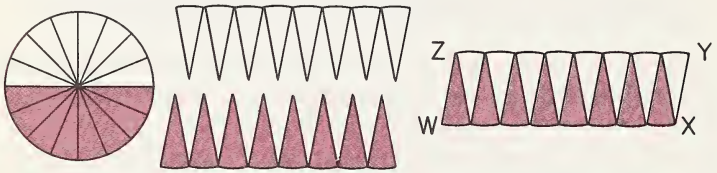
5. How many revolutions does a wheel 28 inches in diameter make in travelling a mile?

★**6.** If a test shows that a tire 28 inches in diameter will give 35,000 miles of service, how many revolutions will the tire make in going this distance?

★**7.** At a uniform speed of 60 m.p.h., how many revolutions will a wheel 28 inches in diameter make in an hour?

The Formula for Finding the Area of a Circle

The picture shows how a cart wheel can be made by using 16 wedges of the same size and placing them as shown. The wedges do not form a true circle.



If we cut a circle into 16 equal parts and place them as shown on the right, the figure WXYZ is formed. The area of this figure is approximately the same as the area of the circle.

1. In the illustration, if we consider WX and YZ as straight lines, what kind of figure is WXYZ?

2. The sum of WX and YZ must be equal to the circumference of the circle. What part of the circumference is WX?

3. What is the formula for finding the area of a parallelogram?

4. If WXYZ is considered to be a parallelogram, what is the base?

The formula for finding the circumference is $C = 2\pi r$. Since $WX = \frac{1}{2}C$, then the base $WX = \frac{1}{2} \times 2\pi r = \frac{2\pi r}{2}$, or πr.

The altitude of the parallelogram is the same as the radius, or r.

$$A = bh = \pi r \times r = \pi r^2 \text{ } (\pi\text{r-square})$$

Just as $3s^2$ means $3 \times s \times s$, so πr^2 means $\pi \times r \times r$. Since the areas of the parallelogram and of the circle are nearly equal, we can understand that the formula for finding the area of a circle is $A = \pi r^2$.

Write the rule for finding the area of a circle.

5. If the radius of a circle is 6 inches, what is the area of the circle?

$r = 6$ $\quad A = \pi r^2$, the formula
$\pi = 3.14$ $\quad A = 3.14 \times 6 \times 6$
$A = ?$ $\quad A = 113.04$

6. If the diameter of a circle is 12 inches, what is the area of the circle?

$d = 12$
$r = ?$
r is $\frac{1}{2}d$; first find r; then proceed as above.

The area of the circle is 113.04 sq.in.

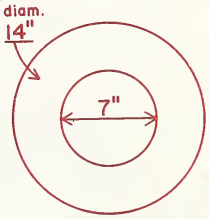
7. Find the area of each of the following circles: (Use $\pi = 3.14$)

a. $r = 5$ ft. c. $d = 6$ in. e. $r = .5$ mi. g. $r = 50$ cm.
b. $r = 10$ in. d. $r = 20$ cm. f. $d = 2$ mi. h. $d = 12$ rd.

8. The illustration on the right shows a cross section of a pipe. What is the area of the hollow part of this cross section?

9. In the figure on the right, what is the diameter of the larger circle? the diameter of the smaller circle? The larger diameter is how many times as large as the smaller diameter?

10. What is the area of the larger circle? What is the area of the smaller circle? (Use $\pi = 3\frac{1}{7}$)



11. In problem 10, the area of the larger circle is how many times as large as the area of the smaller circle?

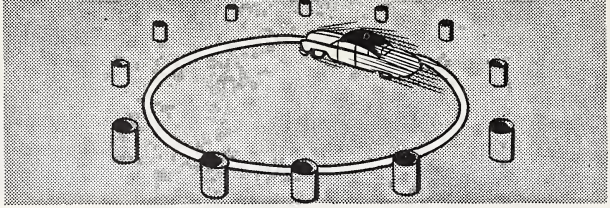
12. What is the circumference of the larger circle? What is the circumference of the smaller circle?

13. In problem 12, the circumference of the larger circle is how many times as large as the circumference of the smaller circle?

★14. If either the diameter or the radius of a circle is doubled, the area is multiplied by what number?

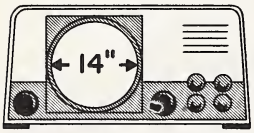
★15. If either the diameter or the radius of a circle is doubled, the circumference is multiplied by what number?

MORE PRACTICE

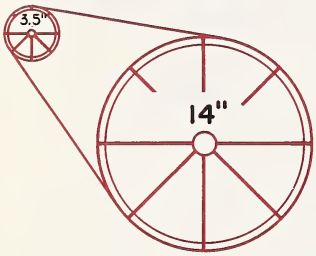


Applications of Circles

1. A test driver drove a new car around a circular track which had a diameter of 37 feet. To the nearest foot, how many feet did the car travel in making one trip around the track?



2. What is the diameter of the screen of the television set shown on the left? What is the area of this screen? The area is how much less than the area of a 14-inch square? (Use $\pi = 3\frac{1}{7}$)



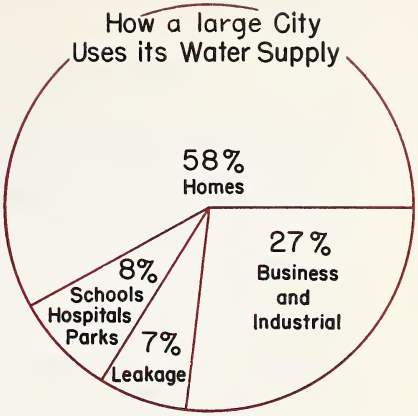
3. What is the diameter of each of the wheels represented on the left? The diameter of the larger wheel is how many times larger than the diameter of the smaller wheel?

4. The picture shows that a belt connects the two wheels. Which wheel will rotate more often in a minute? If the larger wheel makes 50 revolutions in a minute, how many revolutions will the smaller wheel make?

5. The graph shows the effect on buildings which are within a certain radius of the point of explosion of an atomic bomb. These circles are called **concentric circles** (same center). What is the diameter of the smallest circle? The diameter of each succeeding circle increases how much?

★6. What is the area, to the nearest 0.01 square mile, of the section in which all buildings are destroyed?

Making Circle Graphs



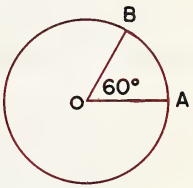
1. What does the graph on the right show?

2. Read the per cent of the water supplied to a large city which is used in homes; in business and industry; in parks, schools, and hospitals. What per cent of the water supply is lost through leakage?

3. If the average amount of water used daily by a person in this city is 150 gallons and the population is 4 million, what is the average daily consumption of water in this city?

4. In problem 2, how many gallons of water are consumed daily by each usage given?

5. How many degrees are there at the center of a circle?



6. In the circle on the right, angle AOB is called a **central angle.** A central angle has its vertex at the center of the circle and the sides of the angle are radii of the circle. How many degrees are there in the acute angle AOB?

7. In order to draw a circle graph, it is necessary to know how many degrees there are in each central angle on the graph. Find the number of degrees in the central angle representing the number of gallons of water used in homes in the city shown in the graph.

The water consumed in homes is 58% of the water supply. It follows, then, that the central angle contains 58% of 360°.

$$58\% \text{ of } 360° = .58 \times 360° = 208.8°$$

To the nearest degree, the central angle is 209°.

8. To the nearest degree, find the number of degrees in the central angle of each of the other parts of the graph given above. How can you check your computation?

How to Make a Circle Graph

To draw a circle graph, you must be able to do two things: First, you must be able to draw an angle of any size; second, you must be able to find the number of degrees in a central angle to represent a part of the graph.

1. Use your protractor to draw each of the following angles:

   a. 55° b. 36° c. 110° d. 147° e. 78°

2. Draw an angle of 210°.

Think, "210° is more than a straight angle, or 180°. 360° − 210° = 150°."

Draw an angle of 150°. The larger of the two angles formed to make a circle contains 210°.

3. Draw an angle of 225°; of 275°; of 305°.

4. To the nearest degree, find each of the following:

   a. 45% of 360° c. 78% of 360° e. 35% of 360°
   b. 7% of 360° d. 16% of 360° f. 62% of 360°

When you know how to draw any angle, you can draw a circle graph. The steps in drawing a circle graph are as follows:

A. If the numbers to be graphed are not expressed as per cents, find what per cent each number is of the total. Round off the per cent to the nearest whole per cent.

In a junior high school, the enrollment was as follows: Grade 7, 145; grade 8, 136; grade 9, 125. Express each number as a per cent of the total. The total is 406. The per cents are as follows: Grade 7, 36%; grade 8, 33%; grade 9, 31%.

B. Multiply 360° by each of the per cents (expressed as decimals) you found in A. Round off the answer to the nearest degree. Each product is the number of degrees in a central angle of the graph.

Referring to the problem in **A**, 36% of 360° = 129.6°, or 130°; 33% of 360° = ? ; 31% of 360° = ?

C. Draw a circle with any convenient radius and then draw the central angles you found in B.

D. Label the graph.

Drawing Circle Graphs

1. In a recent year 52% of the people who purchased cars bought used cars and the others bought new cars. What per cent bought new cars? Show these facts on a circle graph.

2. Of each million cars sold, how many of the cars in problem 1 were used cars? How many were new cars?

3. According to the 1951 Census, 37% of Canada's population live in 15 Metropolitan areas. Show by means of a circle graph the proportion living inside and outside of these Metropolitan areas.

4. A large manufacturing plant found that the sales-dollar of its product for an average of 10 years was distributed as follows: Cost of supplies, 60¢; labor, 17¢; taxes, 4¢; other charges, 15¢; profit, the remainder. Show these facts on a circle graph.

5. The income of the railroads in this country is from the following sources: Freight, 80%; passengers, 11%; other sources, the remainder. Show these facts on a circle graph.

6. The per cent of people having each of the known blood types is as follows: Type A, 41%; type B, 10%; type AB, 4%; type O, 45%. Show these facts on a circle graph.

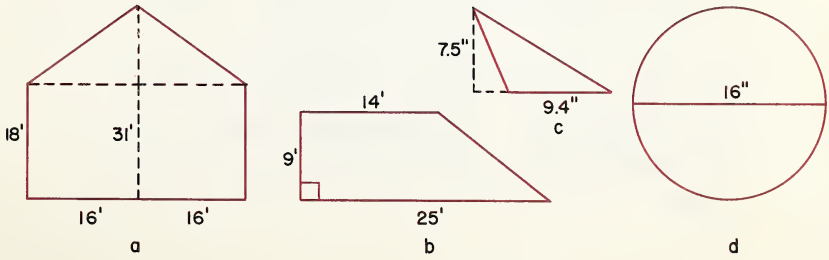
★7. The number of billions of barrels of oil reserves in different parts of the world is estimated to be as follows:

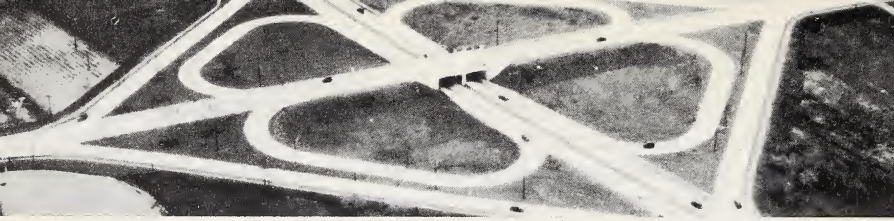
Middle East	27	Canada	7
United States	21	All others	3
Soviet Russia	7		

Show these facts on a circle graph.

Finding Areas of Figures

Find the area of each of the following figures:





ONT. DEPT. OF HIGHWAYS

Using Approximation to Check Answers

1. The picture shows a section of the Queen Elizabeth Way from Toronto to Niagara Falls. The road is 81 miles long.

If the cost of the highway was 75 million dollars, what was the average cost per mile?

Jerry said, "The cost was a little less than a million dollars a mile." Was Jerry right?

Think "81 is approximately 80." Divide 75 million by 80. What is the quotient? Approximately, what was the average cost per mile to the nearest hundred thousand dollars?

2. In 1951 the population of this country was approximately 14 million. The area of the country was 3.61 million square miles. Approximately, what was the number of people per square mile?

By approximation select from the numbers after each example the number that you think is nearest the correct answer. Check your estimate by working the example.

3. 3.8 × 49.5:	150, 200, 22.45, 1885.
4. .465 ÷ .0225:	2.3, 221, 22, 224.
5. 47% of 209:	50, 150, 75, 100.
6. 161 is ?% of 195:	75%, 7.5%, 120%, 37.5%.
7. 58 is 19% of ?:	116, 200, 300, 400.
8. 75.4 ÷ 13.8:	51, 4.96, .52, 48.7.
9. 14.5 × 3.6:	52, 5.2, 520, 467.3.
10. 112% of 1478:	1500, 1550, 1650, 1725.
11. 78 is ?% of 155:	20%, 25%, 200%, 50%.
12. 17 is 48% of ?:	85, 816, 35, 50.

Getting Ready for Progress Test in the Fundamentals

I. Add:

1. 748 / 3259 / 84 / 607 / 4976 / 49

2. .74 / .38 / .96 / .57 / .43

3. $7\frac{1}{3}$ / $4\frac{1}{2}$ / $5\frac{1}{6}$ / $2\frac{1}{4}$

4. $8\frac{1}{2}$ / $9\frac{7}{8}$ / $5\frac{3}{4}$ / $2\frac{3}{8}$

5. 4 lb. 7 oz. / 1 lb. 14 oz.

6. 11 min. 18 sec. / 2 min. 55 sec.

II. Subtract:

1. 4340 − 2587

2. 71,406 − 4,538

3. .740 − .355

4. 2.50 − 1.78

5. .602 − .595

6. $\frac{5}{6} - \frac{3}{8}$

7. $8\frac{1}{3} - 4\frac{5}{6}$

8. $9 - 5\frac{3}{8}$

9. 7 ft. 8 in. − 3 ft. 10 in.

10. 12 lb. − 5 lb. 7 oz.

III. Multiply:

1. 758 × 6

2. 906 × 28

3. 760 × 80

4. 607 × 305

5. .24 × .35

6. $2\frac{1}{2} \times \frac{5}{8} =$

7. $\frac{3}{4} \times 1\frac{1}{2} =$

8. $\frac{5}{7} \times 1\frac{3}{4} \times 2\frac{1}{2} =$

9. 7.24 × 2.01

10. 4.55 × 3.8

11. 4 min. 28 sec. × 3

12. $\frac{1}{2}\%$ of 1240 =

13. 140% of 580 =

14. 2.4% of 170 =

IV. Divide:

1. $6\overline{)5024}$

2. $17\overline{)86134}$

3. $255\overline{)13472}$

4. $1.8\overline{)54}$

5. $.25\overline{)1.4}$

6. $12\overline{)42}$

7. $6 \div \frac{3}{4} =$

8. $\frac{5}{6} \div 4 =$

9. $2\frac{1}{2} \div \frac{5}{6} =$

10. $4\frac{2}{3} \div 5\frac{1}{2} =$

11. $3\overline{)16 \text{ min. } 42 \text{ sec.}}$

12. 36 = ?% of 48

13. 150 = ?% of 125

14. 4 = 2% of ?

The Vocabulary of Arithmetic

Define, illustrate, or use in a sentence each of the terms given below. The number in parentheses shows where the term is explained.

Acute angle	(141)	Obtuse angle	(141)
Altitude	(138)	Parallelogram	(145)
Area	(129)	Protractor	(142)
Central angle	(155)	Radius	(149)
Circumference	(149)	Right angle	(141)
Diameter	(149)	Scalene triangle	(140)
Equilateral triangle	(140)	Straight angle	(141)
Formula	(127)	Trapezoid	(146)
Isosceles triangle	(140)	Vertex	(143)

Writing and Using Formulas

1. Write the formula for finding the perimeter of a square. Find the perimeter of a square having a side of $4\frac{1}{2}$ in.; of 15.8 cm.

2. Write the formula for the perimeter of a rectangle. Find the perimeter of a rectangle 8.5 feet wide and 12.6 feet long.

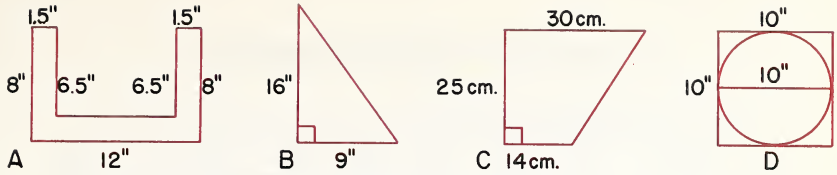
3. Write the formula for finding the area of a triangle. What is the area of a triangle having a base of 14 feet and an altitude of $9\frac{1}{2}$ feet?

4. Write the formula for the perimeter of an equilateral triangle having a side of **s**. Find the perimeter of an equilateral triangle having a side of 8.5 ft.; of 76 cm.

5. The perimeter of an equilateral triangle is 84 inches. What is the length of a side of the triangle?

6. Write the formula for finding the area of a trapezoid. What is the area of a trapezoid having an altitude of 16 inches and parallel sides of 9 inches and 14 inches? (What is another name for the parallel sides?)

7. Write the formula for finding the circumference of a circle; for the area of a circle. Find the circumference and also the area of a circle having a radius of 6 inches. (Use $\pi = 3.14$)



Chapter Test

1. What is the perimeter represented by figure A? What is the area represented by figure A?

2. What kind of triangle is figure B? What is the area represented by this figure?

3. What kind of surface does figure C represent? What is its area?

4. A trapezoid may have two right angles. One of the other angles may be what kind of angle? The fourth angle must be what kind of angle?

5. What is the area of the square represented by D? What is the area of the circle represented in this figure? (Use $\pi = 3.14$)

6. The area of the circle represented in figure D is what per cent of the area of the square?

7. Angle B is the vertex angle of an isosceles triangle ABC. If each of the other two angles is 72°, how many degrees are there in the vertex angle?

8. How many degrees are there in each angle of an equilateral triangle?

9. The perimeter of a square is 46 inches. What is the length of a side of the square?

10. A triangle and a parallelogram have equal bases and equal altitudes. The area of the triangle is what per cent of the area of the parallelogram?

11. Write the formula for finding the perimeter of a rectangle. Find the perimeter of a rectangle which is 9.5′ by 5.8′.

12. A wheel has a diameter of $3\frac{1}{2}$ feet. What is the circumference of the wheel? (Use $\pi = 3\frac{1}{7}$)

13. What is the area of a circle 7 inches in diameter? (Use $\pi = 3\frac{1}{7}$)

Progress Test in the Fundamentals

Solve the following examples:

1.	7025	2.	$12\frac{3}{8}$	3.	860	4.	8.65	5.	$6\frac{1}{3}$
(8)	-38	(25)	$-7\frac{1}{2}$	(11)	$\times 70$	(55)	$\times 7.4$	(22)	$4\frac{1}{2}$
									$9\frac{3}{4}$
6.	$27\overline{)8382}$	7.	$.8\overline{)46}$	8.	$1.2\overline{).06}$	9.	$.001\overline{)1}$		$5\frac{1}{6}$
(16)		(69)		(71)		(69)			

10. $1000 \times 3.14 =$ (57)

11. $\frac{5}{6} \times 1\frac{1}{2} \times 2\frac{1}{4} =$ (29)

12. $\frac{7}{8} \div 1\frac{3}{4} =$ (34)

13. $1 \div \frac{9}{16} =$ (34)

14. 3% of 450 = (92)

15. 102% of 450 = (92)

16. 3 = ?% of 60 (98)

17. 18 = ?% of 12 (108)

18. 45 = 15% of ? (120)

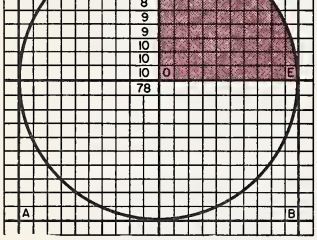
19. $\frac{1}{2}$% of 1450 = (102)

20. 120% of ? = 450 (108)

If you did not understand how to solve an example, turn for help to the page given in parentheses where the step is explained.

★For Those Who Made No Error on the Above Test

You can find the formula for the area of a circle as follows:



1. What is the radius of the circle? What is the side of the square ABCD?

2. What is the area of the square?

3. Count the number of squares in a quarter of the circle, as OFE. If half or more of a square is within the circle, count that square. If less than half of a square is within the circle, do not count that square.

4. Multiply the number of squares in a quarter of the circle by 4. This gives the number of squares in the whole circle. How many are there?

5. If you use the formula $A = \pi r^2$ ($\pi = 3.14$), what is the area? Show that this formula gives about the same number as you found in problem 4.

Test in Problem Solving

Solve the following problems. If you are unable to solve a problem, turn for help to the page indicated on the right of the problem.

1. The value of a 4 which is three places to the right of ones' place is what fractional part of the value of the 2 in .25? (44)

2. A number rounded off to the nearest thousand is 35,000. What is the least value this number could have had before it was rounded off? (4)

3. A city uses 2.5 million gallons of water a day. The reservoir which supplies the city has a capacity of half a billion gallons. How many days' supply of water does it contain when it is full? (24)

4. A calculating machine is able to perform an operation in arithmetic in .02 second. At that rate, how many of the same kind of operation can it perform in one second? (69)

5. When the population of a city increases from 25,000 to 32,500, what is the per cent of increase in the population? (105)

6. A team won 16 games and lost 9 games. What per cent of the games played did the team win? (98)

7. Jim paid $13.50 for a pair of skis which was 60% of the regular price. What was the regular price? (108)

8. Bill's father had a new driveway built which was $7' \times 68'$. At 24¢ a square foot, what was the cost of the driveway? (120)

9. How many degrees should there be in the central angle of a circle graph to represent an item which is 35% of the total? (155)

10. A circular table is 42 inches in diameter. What is the area of the top of this table? (152)

FOR HIRE
ROW BOATS
50¢ Hr. $1.50 DAY
MOTOR BOATS
$2.00 Hr. $12.00 DAY
FOR HIRE
$2.50
PER HR.
DRIVE IT
YOURSELF
$1.50 PER Hr.
+12¢ PER MILE
RATE
FOR OUR
LOANS
from
4% to 6%
LOANS

CHAPTER V

Interest

The pictures on page 164 show how much and for how long we pay for the use of certain things.

1. At the rate given, how much does it cost to rent a boat without an outboard motor for 3 hours? How much does it cost to rent a boat with an outboard motor for the same time?

2. At the rate given, how much does it cost to rent or hire a truck for a 4-hour trip of 87 miles? for a $6\frac{1}{2}$-hour trip of 136 miles?

3. At the rate given for the use of a truck, find the cost of a trip which began at 7:30 A.M. and ended the same day at 4:30 P.M., if the average distance traveled in an hour was 32 miles.

4. At the rate given, how much does it cost to rent or hire a tractor for 6 hours?

5. The amount paid by a farmer for the use of a tractor at the rate given was $85. How many hours was the tractor in use?

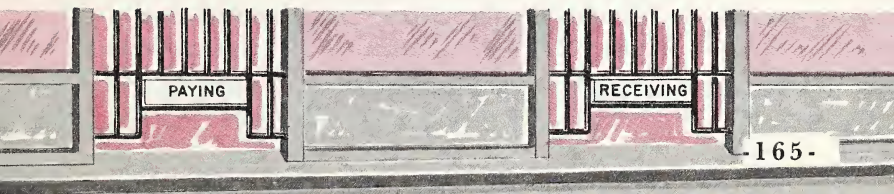
The amount you pay for the use of a boat or a car represents the value of the service the boat or car renders. In like manner, people must pay for the use of money loaned by a bank. The sum paid for the use of money is called **interest.**

6. The **rate of interest** is expressed as a per cent. In the picture on page 164, what rate does the bank charge? This is the rate for a year.

7. When you borrow money, the sum borrowed is called a **loan.** Find the interest for one year on each of the following loans:

a. $600 at 4%	d. $1000 at $3\frac{1}{2}$%	g. $1920 at 6%
b. $450 at 5%	e. $1500 at $4\frac{1}{2}$%	h. $2460 at 3.5%
c. $375 at 3%	f. $2550 at $5\frac{1}{2}$%	i. $1250 at 2.5%

8. Give the meaning of the items in the bank windows.



The Interest Formula

We know that the interest on \$100 at 6% for one year is \$6.

1. What do we call the \$100? the 6%? the 1 year?

2. Using the terms **principal**, **rate**, and **time**, write a rule for finding interest.

3. The **interest formula** is $\mathbf{i = prt}$. Tell what the **i** represents; the **p**; the **r**; the **t**.

4. Jack repaid a loan of \$150 and an additional \$3 for interest. The **amount** he had to pay was equal to principal plus interest. What was the amount Jack paid? If **A** = amount, **p** = principal, and **i** = interest, write a formula for finding the amount.

5. Use the formula $\mathbf{A = p + i}$ to find **A**, when **p** = \$250 and the rate of interest is $2\frac{1}{2}\%$ for 1 year. (First find **i**. Then substitute values of both **p** and **i** in the above formula for finding the amount.)

Find the interest and the amount of each of the following loans:

	Principal	Rate	Time		Principal	Rate	Time
6.	\$750	3%	1 yr.	10.	\$150	6%	$\frac{1}{4}$ yr.
7.	\$375	4%	$\frac{1}{2}$ yr.	11.	\$280	5.5%	$\frac{3}{4}$ yr.
8.	\$1240	$3\frac{1}{2}\%$	$1\frac{1}{2}$ yr.	12.	\$2250	4.2%	$\frac{1}{2}$ yr.
9.	\$600	$4\frac{1}{2}\%$	$\frac{1}{2}$ yr.	13.	\$4500	3.8%	1 yr.

14. When the amount is \$960 and the interest is \$24, what is the principal?

★15. Write a formula for finding the principal when the amount and the interest are given.

★16. Tell how the interest varies in each of the following cases. Give an illustration to prove each of your answers.

a. Principal is doubled, but the rate and the time are unchanged.

b. Rate is doubled, but the principal and the time are unchanged.

c. Time is doubled, but the principal and the rate are unchanged.

Finding Interest for Short Periods of Time

Banks often make loans for a period of a few weeks or months. Bankers use 365 days as a year in computing interest.

1. Find the interest on a loan of \$750 at 4% for 45 days.

Principal = \$750
Rate = 4%
Time = $\frac{45}{365}$ yr.
Interest = ?
The interest is \$3.70.

The interest on \$750 at 4% for 1 year is equal to 4% of \$750, or .04 × \$750 = \$30.00. Interest for $\frac{45}{365}$ year is $\frac{45}{365}$ × \$30, or \$3.70.

2. In problem 1, what is the interest for 1 year? If the interest for 1 year is given, how do we find the interest for $\frac{135}{365}$ year?

To find the interest on a loan for a fractional part of a year, find the interest for 1 year and then multiply this amount by the fractional part of one year.

3. Solve problem 1 by substituting the values given in the interest formula **i = prt.** Since **p** = \$750, **r** = $\frac{4}{100}$, and **t** = $\frac{45}{365}$, the formula becomes **i** = \$750 × $\frac{4}{100}$ × $\frac{45}{365}$. Find **i.**

Find the interest, to the nearest cent, on the following loans:

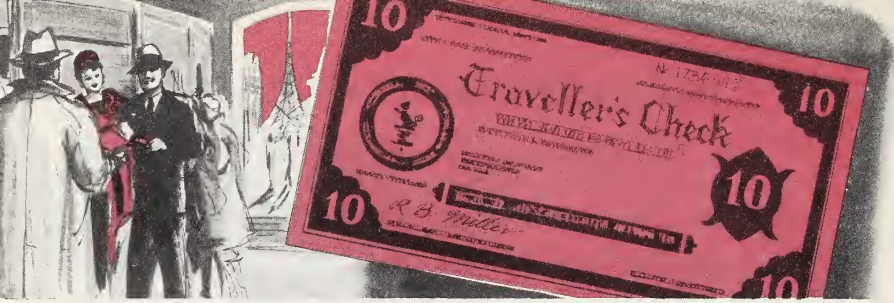
	Principal	Rate	Time		Principal	Rate	Time
4.	\$500	6%	36 da.	8.	\$250	5%	75 da.
5.	\$750	4%	30 da.	9.	\$780	$4\frac{1}{2}$%	72 da.
6.	\$225	6%	60 da.	10.	\$1750	4%	45 da.
7.	\$950	$4\frac{1}{2}$%	60 da.	11.	\$2250	$5\frac{1}{2}$%	30 da.

The federal government uses the calendar year, 365 days for an ordinary year and 366 days for a leap year, in computing interest. Interest computed in this way is called **exact interest** The interest computed in the problems above is called **simple interest**

★12. To the nearest cent, find the exact interest on each of the following for a year of 365 days.

a. \$800 at 6% for 30 da.
b. \$300 at 5% for 60 da.
c. \$1000 at 4% for 45 da.
d. \$1500 at 3% for 90 da.

MORE PRACTICE 383



A Personal Check Is Not Always Accepted

Mr. P. R. Miller has taken his family on a tour. In a strange city he needs cash, but he is not able to get a **personal check** cashed. A personal check is one which is drawn on his checking account in a bank in his home community. But Mr. Miller can cash a **traveller's check** which he purchased from a bank before he started on the trip. The illustration shows part of a travellers' check on which Mr. Miller has written his name.

1. It was necessary for Mr. Miller to sign the check when he purchased it. How does his signature on the check serve as a protection in case the check is lost or stolen?

2. Indicate the place on the check where Mr. Miller must sign his name again before he can cash the check. How does his signature serve as a protection to the person cashing the check?

3. Travellers' checks may be bought in denominations of \$10, \$20, \$50, and \$100. The bank issuing these checks charges a **fee** of $\frac{3}{4}\%$ of the value of a check for this service. Find the charge or fee for travellers' checks each having the value of:

a. \$100 b. \$500 c. \$1000 d. \$760 e. \$1240

4. Find the charge or fee for 6 travellers' checks, each of which has a **face value** of \$50; of 8 checks, each of which has a face value of \$100.

5. Find the total cost (face value plus fee) of 4 checks, each of which has a face value of \$50; of \$100.

★6. Why is it easier for a person to cash a travellers' check in a place where he is not known than it is for him to cash a personal check?

Finding the Rate of Interest

"I'll lend you \$200 at 5%," said Mr. Barton to Mr. Post. Mr. Barton meant that the rate of interest charged would be 5% a year. **The rate of interest means the rate per year.**

1. Find the rate of interest when the interest on a loan of \$500 for 1 year is \$20.

\$20 ÷ \$500 = .04 = 4%, the rate of interest.

2. Find the rate when the time for each is 1 year:

	Principal	Interest		Principal	Interest		Principal	Interest
a.	\$400	\$20	c.	\$500	\$25	e.	\$2000	\$70
b.	\$750	\$30	d.	\$800	\$48	f.	\$1200	\$54

3. Find the yearly rate of interest when the rate is:

a. $\frac{1}{2}$% a month c. 1% quarterly ($\frac{1}{4}$ yr.) e. $\frac{3}{4}$% for 6 mo.
b. $\frac{3}{4}$% a month d. $\frac{3}{4}$% quarterly f. $1\frac{1}{2}$% monthly

4. Find the rate of interest on a loan of \$1250 when the interest for 3 months is \$25.

p = \$1250
i = \$25 for $\frac{1}{4}$ yr.
or **i** = \$100 for 1 yr.
r = ?

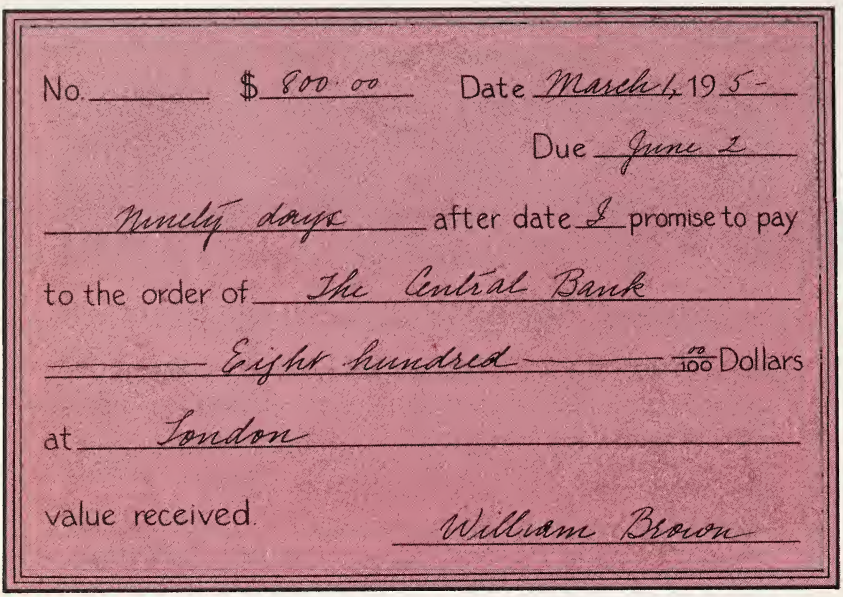
If the interest is \$25 for 3 mo. ($\frac{1}{4}$ yr.), the interest for a year is 4 × \$25, or \$100.
\$100 ÷ \$1250 = .08 = 8%.
The rate of interest is 8%.

To find the rate of interest, divide the yearly interest by the principal and express the quotient as a per cent.

Find the rate of interest on each of the following:

	Principal	Interest	Time		Principal	Interest	Time
5.	\$750	\$15	6 mo.	10.	\$1000	\$12.50	6 mo.
6.	\$800	\$10	3 mo.	11.	\$1500	\$18.75	3 mo.
7.	\$320	\$ 8	6 mo.	12.	\$2500	\$12.50	1 mo.
8.	\$900	\$18	3 mo.	13.	\$1750	\$35.00	6 mo.
9.	\$750	\$10	4 mo.	14.	\$3000	\$37.50	3 mo.

15. If the interest on a loan of \$800 for 6 months is \$18, what is the rate of interest.


No. _____ $ 800 00 Date March 4, 19 5-

Due June 2

Ninety days after date I promise to pay

to the order of The Central Bank

Eight hundred 00/100 Dollars

at London

value received. William Brown

Promissory Notes

Borrowing money from a bank. Mr. Brown borrows $800 from the bank in order to pay cash for his merchandise. He expects to sell the goods at a profit within 90 days, so he borrows this money for that period at 6%. He gives the bank **a time note** for $800. The note is due on May 4, but in Canada Mr. Brown is allowed 3 additional days, called **days of grace,** in which to pay. These extra 3 days make the note legally due on May 7. Interest must be paid on these 3 extra days.

The date in the upper right-hand corner is the date when the note was written. This is called the **date of the note.** The day on which the note is due is called the **date of maturity.** Mr. Brown is the **maker** of the note. The sum of $800. written on the note is called **the face of the note.** The Royal Bank of Canada, to which the money is to be paid, is called the **payee.**

How interest on a note is computed. For how many days did the bank lend the $800. to Mr. Brown?

Think: Feb. 3 to Feb. 28 = 25 days
Feb. 28 to Mar. 31 = 31 days
Mar. 31 to Apr. 30 = 30 days
Apr. 30 to May 7 = 7 days
93 days

The bank charged interest for 93 days.

To find the interest paid by Mr. Brown, use the formula:

$$i = prt$$

What does each letter in the formula represent?

To find the interest on \$800. for 93 days at 6% proceed as follows:

When a loan is made for a certain number of days, the interest is calculated on 365 days a year.

$$i = 800 \times \frac{6}{100} \times \frac{93}{365} = \$12.23$$

Find the interest on the following bank loans:

	Principal	Time	Rate		Principal	Time	Rate
1.	\$250	30 da.	6%	11.	\$2,500	27 da.	4%
2.	\$730	30 da.	6%	12.	\$3,250	60 da.	4%
3.	\$675	60 da.	4%	13.	\$1,650	15 da.	6%
4.	\$485	90 da.	5%	14.	\$1,275	83 da.	6%
5.	\$325	60 da.	4%	15.	\$1,845	64 da.	5%
6.	\$180	90 da.	5%	16.	\$2,200	70 da.	5%
7.	\$545	45 da.	6%	17.	\$2,750	40 da.	6%
8.	\$860	75 da.	6%	18.	\$1,956	18 da.	7%
9.	\$935	36 da.	7%	19.	\$3,500	48 da.	4%
10.	\$748	72 da.	5%	20.	\$2,375	88 da.	5%

21. Write a note payable at the Bank of Montreal, using the items mentioned in the first problem.

Who is the maker? What is the face of the note? What is the date of maturity? What amount must the maker pay on the date of maturity?

Discounting a Note

When Mr. Brown made the note shown on page 170, the bank deducted the interest on the loan in advance. Interest deducted in advance is called **bank discount**. The difference between the face value of the note and the interest is called the **proceeds**.

1. Find the proceeds of the note given on page 170.

P = **\$800**
r = **6%**
t = **93 da.**
i = **800 x** $\frac{6}{100}$ **x** $\frac{93}{365}$
Proceeds = **?**

\$800.00, Principal
−12.23, Bank discount (Interest)
\$787.77 Proceeds

The interest (**i**) is \$12.23, the proceeds are \$787.77.

2. When Mr. Ross repays the loan, must he pay \$800. or \$787.77. Why?

3. What are the proceeds on a loan of \$250 when the bank discount is \$3.80.

4. What is the bank discount when the proceeds from a loan of \$450 are \$437.50?

Find the bank discount and the proceeds on each of the following:

	Principal	Rate	Time		Principal	Rate	Time
5.	\$400	6%	30 da.	10.	\$1,250	4%	30 da.
6.	\$500	4%	60 da.	11.	\$1,500	5%	73 da.
7.	\$250	6%	45 da.	12.	\$1,800	$4\frac{1}{2}$%	60 da.
8.	\$725	4%	36 da.	13.	\$2,500	5%	45 da.
9.	\$950	$5\frac{1}{2}$%	36 da.	14.	\$2,000	6%	32 da.

★15. If **F** = the face value of a note, **d** = the bank discount, and **p** = the proceeds, you can write the formula for finding **p**. Find **p** when **F** = \$375 and **d** = \$9.43, using your formula.

★16. Using the letters in problem 15, write the formula for finding **d**. Find **d** when **F** = \$250 and **p** = \$243.50

How to Find the Date on which a Note Matures

1. On July 15, Harry borrowed $100 from his father to complete his farm-club project. His father knew that Harry's corn field would yield a large crop. Harry gave his father a promissory note for 90 days at 6% interest.

How much did Harry pay his father on the date of maturity? On what date was the money legally due?

To find the date of maturity proceed as follows:

16 da. left in July
31 da. in August
30 da. in September
16 da. in October
93 da., the time of the note.

Count from the date of the note until the number of days stated in the note, plus 3, has been counted.

The legal date of maturity of Harry's note was Oct. 16.

2. If the note had been for 3 months, the date of maturity would be found by counting forward 3 months from the date of the note and then adding 3 days. Why? The date of maturity would have been October 19.

3. Find the legal date of maturity of the following:

	Date of Note	Time	Date of Note	Time
a.	Aug. 12, 1940	60 da.	c. Jan. 1, 1941	3 mo.
b.	Oct. 14, 1941	90 da.	d. Jan. 1, 1942	90 da.

4. On January 12, 1945, Mr. Smith wished to find how many days remained before the date of maturity of a 60-day note, dated December 15, 1944. How many days were left?

5. On April 1, 1944, Mr. Aird wished to find the number of days to the date of maturity that remained on a 3-month note, dated March 4, 1944. How many days were left?

FIRST QUARTER																									
JANUARY								FEBRUARY								MARCH									
S	M	T	W	T	F	S		S	M	T	W	T	F	S		S	M	T	W	T	F	S	
1	2	3	4	5	6	7					1	2	3	4							1	2	
8	9	10	11	12	13	14		5	6	7	8	9	10	11		3	4	5	6	7	8	9	
15	16	17	18	19	20	21		12	13	14	15	16	17	18		10	11	12	13	14	15	16	
22	23	24	25	26	27	28		19	20	21	22	23	24	25		17	18	19	20	21	22	23	
29	30	31						26	27	28	29	30				24	25	26	27	28	29	30	

The World Calendar

Our calendar is the Gregorian calendar. Various plans have been proposed to improve this calendar. One of the plans, which has the approval of seventeen countries, is that used in the World Calendar. Under that plan, the year is divided into quarters, each having the same number of days and months.

1. The first quarter of the World Calendar is illustrated above. How many days are there in each quarter? How many days are there in the four quarters?

2. According to our calendar, are there the same number of days in each three-month period? How many days are there in each? How many days are there in the year?

3. In the World Calendar, on which day of the week does the first quarter begin? On which day does it end? Since the quarters are of equal length, on which day does each quarter begin? On which day does each end?

The 365th day each year, to be known as **Worldsday** or **W-December** and the extra day every fourth year, to be known as **Leapyear Day** or **W-June**, would be celebrated as holidays if the new calendar were adopted. They would not be counted as days of any week. Each would be between Saturday and Sunday. W-December would fall between December 30 and January 1. W-June would be between June 30 and July 1.

4. If the World Calendar were adopted, on which day of the week would Christmas fall? Which day would be your birthday?

★5. Make a list of some of the advantages of the World Calendar over our present calendar; some disadvantages.

Practise What You Have Learned

1. $\begin{array}{r} 4.75 \\ 9.38 \\ 0.56 \\ 2.84 \\ \underline{7.49} \end{array}$

2. $\begin{array}{r} 3\frac{1}{4} \\ 2\frac{1}{2} \\ 4\frac{7}{8} \\ \underline{7\frac{9}{16}} \end{array}$

3. $\begin{array}{r} 40{,}102 \\ \underline{-32{,}946} \end{array}$

4. $\begin{array}{r} 608 \\ \underline{\times 307} \end{array}$

5. $\begin{array}{r} 78 \\ \underline{\times 6\frac{3}{4}} \end{array}$

6. $\begin{array}{r} .075 \\ \underline{-.069} \end{array}$

7. $\begin{array}{r} 5 \\ \underline{-4\frac{3}{8}} \end{array}$

8. $\begin{array}{r} 9\frac{1}{4} \\ \underline{-2\frac{5}{6}} \end{array}$

9. $\frac{5}{6} \times 1\frac{1}{2} =$

10. $9\frac{1}{2} \times 2\frac{3}{4} \times 1\frac{1}{3} =$

11. $7\frac{1}{2} \div 3\frac{1}{4} =$

12. $6\overline{)4.5}$

13. $.15\overline{)9}$

14. $8\overline{)3}$

15. $150 \div \frac{5}{6} =$

16. 104% of 450 =

17. $\frac{1}{2}$% of 1240 =

18. 3.4% of 750 =

19. 25 = ?% of 40

20. 36 = ?% of 25

21. 180 = ?% of 120

22. 50 = 2% of ?

23. 150% of ? = 60

24. 70 = 5% of ?

25. Find the value of $\frac{9}{16}$ to the nearest hundredth.

Number Quickies

1. The side of an equilateral triangle is what per cent of the perimeter of the triangle?

2. A square has a perimeter of 32 centimeters. What is the length of a side? What is the area of the square?

3. An airplane is flying at a speed of 330 m.p.h. How far is the airplane traveling in 10 minutes at that speed?

4. What is the product of $9 \times 4 \times 7 \times 0$?

5. The product of two fractions is $\frac{1}{2}$. If one of the fractions is $\frac{4}{5}$, what is the other fraction?

6. The diameter of a shell for a gun is 75 millimeters. If there are about 2.5 centimeters in an inch, approximately how many inches is the diameter of the shell?

7. When the price of a dozen eggs increases from 60¢ to 65¢, what is the per cent of increase in cost?

8. An article was sold for $20. The selling price was 80% of the regular price. What was the regular price?

9. If 60% of a number is 480, what is the number?

10. What is the sum of the numbers from 1 to 9 inclusive?

Using a Table for Finding the Time of a Loan

In order to save time and to insure greater accuracy in work, tables may be used to find the number of days from one date to another date. The following table may be used for this purpose.

From any day of	To the same day of the next											
	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Jan.	365	31	59	90	120	151	181	212	243	273	304	334
Feb.	334	365	28	59	89	120	150	181	212	242	273	303
Mar.	306	337	365	31	61	92	122	153	184	214	245	275
Apr.	275	306	334	365	30	61	91	122	153	183	214	244
May	245	276	304	335	365	31	61	92	123	153	184	214
June	214	245	273	304	334	365	30	61	92	122	153	183
July	184	215	243	274	304	335	365	31	62	92	123	153
Aug.	153	184	212	243	273	304	334	365	31	61	92	122
Sept.	122	153	181	212	243	273	303	334	365	30	61	91
Oct.	92	123	151	182	212	243	273	304	335	365	31	61
Nov.	61	92	120	151	181	212	242	273	304	334	365	30
Dec.	31	62	90	121	151	182	212	243	274	304	335	365

In a leap year, add one day if the period includes Feb. 29.

1. How many days are there from June 20 to September 25?

In the column on the left, find "June" and proceed to the right to the column headed "Sept." Read the number which is in both the row for June and the column for September. This number is 92.

There are 92 days from June 20 to Sept. 20. There are 5 days more to Sept. 25, making a total of 92 da. + 5 da. or 97 da.

2. 3 mo. from July 10
3. 2 mo. from Aug. 8
4. From Mar. 5 to July 17
5. From Jan. 4 to May 5 in 1952

Money in Circulation

The graph shows the value of the money in circulation in this country in a recent year.

1. Each symbol on the graph represents how much money?

2. What was the approximate value of coins and bills of $1, $2, and $5 in circulation?

3. What was the approximate value of bills of $50 and over in circulation?

4. What was the approximate value of bills of $10 and $20 in circulation?

5. What was the approximate value of all money in circulation?

6. If approximately 1.4 billion dollars were in circulation and our population was 14 million, about what was the average number of dollars in circulation per person?

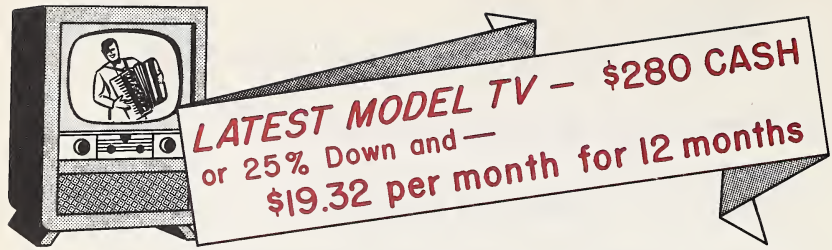
7. How many different coins having a value of $1 or less are there in our money system? What is the total value of one of each of these coins?

★8. Find out what the different units or denominations of our paper money are. What is the total value of one bill of each different denomination in our money system?

Practising Percentage

Find the missing number in each of the following:

	a	b	c
1.	3% of 750 = ?	75 = ?% of 120	4 = 2% of ?
2.	102% of 950 = ?	33 = ?% of 25	125% of ? = 75
3.	$\frac{1}{4}$% of 840 = ?	7 = ?% of 140	36 = 5% of ?
4.	175% of 675 = ?	125 = ?% of 50	200% of ? = 46
5.	18 = 3% of ?	$\frac{1}{2}$% of 1250 = ?	104% of 310 = ?



Buying on the Instalment Plan

Often a customer does not have enough cash to pay for an article. In many cases the merchant will take a down payment on an article and then permit the purchaser to make a given number of regular payments by the week or month until the purchase price is paid. This form of payment is known as **instalment buying**

1. What is the cash price of the television set?

2. How much more is the total cost of the television set when purchased on the instalment plan than when purchased for cash?

3. The merchant selling the television set gave credit to the purchaser, who in reality borrowed the money from the merchant to buy the set. The principal of the loan is the difference between the cash price and the down payment. How much was the principal of the loan?

4. In problem 3, the amount of the loan includes principal and interest. The amount of a loan is the difference between the instalment price and the down payment. How much is the amount of the loan on this television set?

5. From problems 3 and 4, show that the interest on the loan is approximately $22.

6. What is the interest on a loan of $210 at 6% for 1 year? This sum is how much less than the interest the merchant charged for a loan of $210 for a year?

★7. Make a list of some of the advantages of instalment buying. Make a list of some of its disadvantages.

★8. During periods of war or of great national emergency, our government restricts the use of instalment credit. Give one or two reasons why this is necessary.

Finding the Charge for Instalment Buying

The difference between the cash price of an article and the price on the instalment plan is the charge for this method of purchasing. This difference may be thought of as the interest charge which the seller makes to the puchaser for the loan. Sometimes a merchant must take back an article sold on the instalment plan because the purchaser is not able to make all instalment payments. In this case the merchant may have a loss on the sale. For this reason, the rate of interest on instalment loans is usually higher than rates charged at banks for ordinary loans.

Find the missing numbers in the following table:

Article	Cash Price	Down Payment	Monthly Payment	Number of Payments	Instalment Price	Interest Charge
1. Television set	$200	25%	$11.34	15	$220.10	$20.10
2. Television set	$300	25%	$26.80	9	?	?
3. Washing machine	?	$39.90	$14.13	12	?	$9.96
4. New car	$2000	$666.67	$96.95	15	?	?
5. Furniture	?	$36	$15	15	?	$11.00
6. Used car	?	$100	?	15	$448.75	$53.75
★7. Wire recorder	$99.50	10%	$7.91	?	$104.87	?
★8. Typewriter	$135	20%	$10.25	?	$150	?

9. A vacuum cleaner sold for $96.50 cash or for a down payment of $32.50 and 8 equal monthly payments of $9.25. What was the difference between the cash price and the instalment price?

10. A loan company will grant a loan of $1500 for the purchase of a new car, to be paid off in 15 equal monthly payments of $109.96 each. What is the interest charge for this loan? How much more is this charge than the interest at 6% on a loan of $1500 for 15 months?

★11. A refrigerator sold for $240 cash or for 25% down and 6% on the unpaid balance. If the loan was paid off in 12 equal monthly instalments, what was the amount of the payment at the end of the first month (principal plus interest)?

Buying a House

The Russells wished to buy the house shown above, but they did not have the cash necessary to pay for it. The owner of the house offered to accept 25% of the purchase price as a down payment, and to take a **mortgage** at 5% on the unpaid balance.

A mortgage is a written pledge of property for the payment of a debt. The face value of the mortgage is called the **principal.**

The Russells bought the house according to the plan offered by the owner.

1. How much was the down payment? How much was the principal of the mortgage?

2. How much was the yearly interest on the principal of the mortgage?

3. The Russells paid the interest **semi-annually** (twice a year). How much was the semi-annual interest?

4. Find the missing numbers in the following table:

	Value of Property	Down Payment	Principal of Mortgage	Rate of Interest	Semi-annual Interest
a.	$7500	20%	?	5%	?
b.	$9900	10%	?	6%	?
c.	$6000	25%	?	$4\frac{1}{2}$%	?
d.	$12,000	?	$9600	5%	?
e.	$10,500	$1500	?	5%	?
f.	?	$2400	$7600	4%	?

★5. Suppose that the holder of a mortgage is forced to sell the property to collect both principal and interest. If the property is sold for less than the mortgage, who bears the loss?

★6. Mr. and Mrs. Jones bought a house for $10,000 which was mortgaged at 80% of its value. They paid off the mortgage at the rate of $50 a month. What was the principal of the mortgage at the end of 4 years?

Buying a House Through N.H.A.

Mr. Curtis does not have cash enough to buy a house. He is able to secure a loan through N.H.A. (see page 132), which enables him to buy the house if he meets certain requirements set up by this federal organization. After he secures the loan, there is an interest charge on it. Mr. Curtis repays the loan in equal monthly instalments. Each payment includes a part of the principal and of the interest. The table gives the monthly payment on a loan of $1000 at different rates and for different lengths of time.

Rate	Monthly Payment on a Loan of $1000		
	10 Yr.	15 Yr.	20 Yr.
$4\frac{1}{2}\%$	$10.37	$7.65	$6.33
5%	10.61	7.91	6.60
$5\frac{1}{2}\%$	10.86	8.18	6.88
6%	11.11	8.44	7.17

1. What is the cost per month to pay off a loan of $1000 at 5% in 10 yr.? in 15 yr.? in 20 yr.?

2. What is the total amount paid on a loan of $1000 at 6% in 15 years? How much more is this than the principal of the loan?

3. Find the monthly payment on a loan of $6500 at $5\frac{1}{2}\%$ for 10 yr.; for 15 yr.; for 20 yr. (Making a loan of $6500 is equivalent to making a loan of $1000 how many times?)

4. How much more interest is paid on a loan of $1000 for the entire period of 20 years when the rate is 6% than when it is $4\frac{1}{2}\%$?

5. Find how much less the principal is than the total amount paid for a loan in each of the following:

a. $5000 at $5\frac{1}{2}\%$ for 10 yr.
b. $8000 at $4\frac{1}{2}\%$ for 15 yr.
c. $6400 at 6% for 20 yr.
d. $7500 at 5% for 15 yr.

★**6.** Mr. Harris bought a house for $9500. He paid 20% down and secured a loan through the N.H.A. for the unpaid balance at 5% for 20 years. What were his monthly payments on the loan?

Ewing Galloway

Owning or Renting a House

The Baxter family recently moved to Glenville. The family could rent an apartment in one of the garden type apartments shown here, or buy a house. The rent in the apartment was $22.50 a room and the cost of a suitable house was $12,000. The Baxters wanted to know which would be cheaper.

1. If the Baxters needed an apartment containing 5 rooms, how much was the rent per month? How much was the rent per year?

2. If Mr. Baxter bought a house for $12,000, he had to pay 20% down. Then he could arrange a loan through the N.H.A. for the unpaid balance. How much would the down payment be? How much would the loan be?

3. Use the table on page 181 to find the monthly payment on a loan of $9600 at 5% for 20 years.

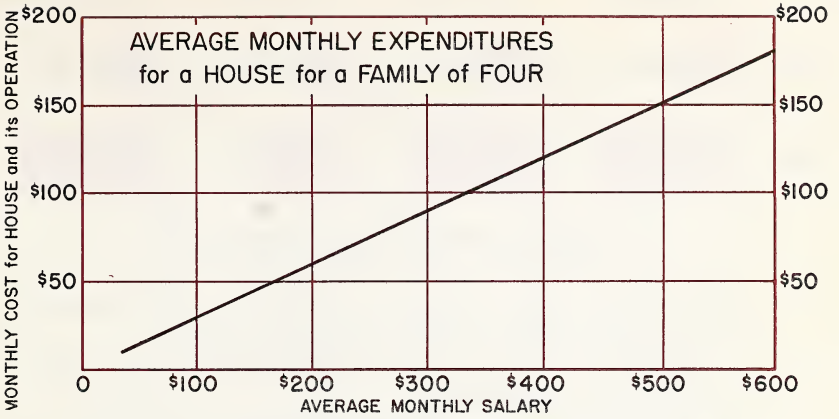
4. In problem **3**, the monthly payment is partly principal and partly interest. Why should the part of the payment which is principal be considered as savings?

5. The amount a family can afford to pay for a house depends upon the yearly income of the family. In considering the amount to be spent for a house, some authorities recommend that the greatest expenditure be as follows:

	Yearly Income	Cost of House		Yearly Income	Cost of House
a.	$1500	$5000	**c.**	$3000	$7000
b.	$2000	$5600	**d.**	$4500	$9000

To the nearest per cent, what per cent of the yearly income is the cost of the house for each income?

6. The Morris family owns a house which is valued at $12,500. If this money were drawing interest at $3\frac{1}{2}\%$, how much would be the yearly income from this money? Show why the yearly interest should be considered as part of the cost of owning a house.



Budgeting for the House

The graph shows the average monthly cost of renting or purchasing a house plus the cost of operating it. The operation costs include such expenses as heat, light, upkeep, and taxes. The data for the graph represent the average cost for a family of four living in cities and towns in this country at a recent date.

1. From the graph, find the approximate average cost per month of a house and its operation when the monthly income of a family is $100; $200; $300; $500.

2. Use the graph to show that when the income is doubled, on the average, the cost of owning and operating a house is doubled, provided that the monthly income is not greater than $600.

3. From the graph, find the approximate monthly income of a family when the monthly cost of a house and its operation is $50; $60; $75; $125.

4. A family of four has a yearly income of $5000. About what is the average cost of running and maintaining a house for this family?

★5. According to the graph, about what per cent of the monthly income is the cost of purchasing and operating a house?

★6. What are some of the things which might affect the cost of buying or renting a house and operating it so that the cost would not be the same as the average cost given on the graph?

	CITY A	CITY B	CITY C	CITY D
1940	$5200	$7300	$4500	$5500
1950	$13,600	$13,400	$8900	$15,100

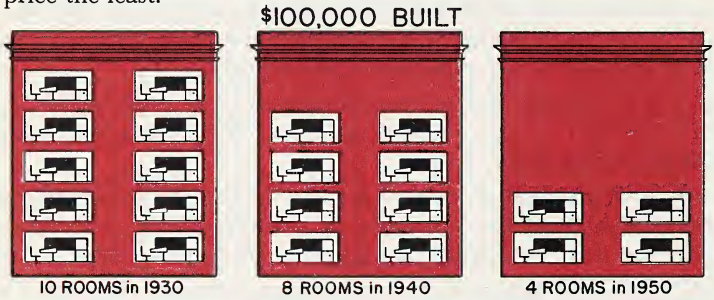
Housing Prices Have Doubled

The graph gives the average price of houses of the same size and structure in four different cities in 1940 and in 1950.

1. In which of the cities given in the table above was the increase in price of houses the greatest?

2. To the nearest per cent, find the increase in price of houses in City A; in City B; in City C; in City D.

3. In which city was the per cent of increase in the price of a house the greatest? In which city was the per cent of increase in price the least?



4. The graph above shows the number of classrooms which could be built for $100,000 in three different years. How many classrooms could be built for this amount in 1930? in 1940? in 1950?

5. What was the average cost of building a classroom in 1930? in 1940? in 1950?

★6. If building costs are 80% higher now than they were 10 years ago, what would have been the cost, 10 years ago, of building a house which now costs $9000?

★7. Why are not building costs the same for all parts of this country?

Getting Ready for the Progress Test in the Fundamentals

I. Add:

1. $\begin{array}{r} 456 \\ 7238 \\ 97 \\ 604 \\ \underline{39} \end{array}$

2. $\begin{array}{r} .76 \\ .95 \\ .43 \\ \underline{.20} \end{array}$

3. $\begin{array}{r} 6\frac{1}{2} \\ 2\frac{1}{4} \\ 1\frac{3}{8} \\ \underline{2\frac{1}{8}} \end{array}$

4. $\begin{array}{r} 1\ \frac{1}{6} \\ 2\ \frac{1}{3} \\ 3\ \frac{1}{2} \\ \underline{4\frac{7}{12}} \end{array}$

5. $\begin{array}{r} 5 \text{ ft. } 8 \text{ in.} \\ 3 \text{ ft. } 6 \text{ in.} \\ 8 \text{ ft. } 9 \text{ in.} \\ \underline{11 \text{ in.}} \end{array}$

II. Subtract:

1. $\begin{array}{r} 9043 \\ \underline{756} \end{array}$

2. $\begin{array}{r} 5144 \\ \underline{4897} \end{array}$

3. $\begin{array}{r} 81{,}435 \\ \underline{71{,}967} \end{array}$

4. $\begin{array}{r} .450 \\ \underline{.375} \end{array}$

5. $\begin{array}{r} .042 \\ \underline{.037} \end{array}$

6. $\begin{array}{r} 7 \\ \underline{\frac{5}{8}} \end{array}$

7. $\begin{array}{r} 9\frac{3}{4} \\ \underline{1\frac{7}{8}} \end{array}$

8. $\begin{array}{r} 15\frac{2}{3} \\ \underline{7\frac{3}{4}} \end{array}$

9. $\begin{array}{r} 7 \text{ lb. } 4 \text{ oz.} \\ \underline{3 \text{ lb. } 9 \text{ oz.}} \end{array}$

10. $\begin{array}{r} 4 \text{ min. } 9 \text{ sec.} \\ \underline{3 \text{ min. } 45 \text{ sec.}} \end{array}$

III. Multiply:

1. $\begin{array}{r} 467 \\ \underline{8} \end{array}$

2. $\begin{array}{r} 309 \\ \underline{7} \end{array}$

3. $\begin{array}{r} 496 \\ \underline{28} \end{array}$

4. $\begin{array}{r} 904 \\ \underline{308} \end{array}$

5. $\begin{array}{r} 780 \\ \underline{60} \end{array}$

6. $\begin{array}{r} 5.4 \\ \underline{.9} \end{array}$

7. $\begin{array}{r} .37 \\ \underline{.3} \end{array}$

8. $\begin{array}{r} 58 \\ \underline{7\frac{3}{4}} \end{array}$

9. $\begin{array}{r} 87\frac{2}{3} \\ \underline{8} \end{array}$

10. $\begin{array}{r} 8.5 \\ \underline{3.7} \end{array}$

11. $\frac{2}{3}$ of 88 =

12. $1\frac{1}{2} \times \frac{5}{6} =$

13. $2\frac{1}{2} \times 4\frac{2}{3} \times 3\frac{1}{4} =$

14. $.2 \times .3 =$

15. 40% of 750 =

16. 3.2% of 180 =

IV. Divide:

1. $7\overline{)3025}$

2. $14\overline{)9912}$

3. $57\overline{)16342}$

4. $275\overline{)13496}$

5. $4\overline{)5}$

6. $.04\overline{)3}$

7. $.16\overline{)25.6}$

8. $1.5\overline{).09}$

9. $84 \div \frac{3}{4} =$

10. $\frac{5}{8} \div \frac{5}{6} =$

11. $1\frac{1}{2} \div 3\frac{1}{4} =$

12. $1 \div 1\frac{2}{3} =$

13. 40 = ?% of 60

14. 60 = ?% of 50

15. 30 = 5% of ?

16. 4% of ? = 60

17. $\frac{1}{4}$% of 860 =

18. 120 = ?% of 75

The Vocabulary of Arithmetic

Define, illustrate, or use in a sentence each of the terms given below. The number in parentheses shows where the term is introduced.

Amount	(166)	N.H.A.	(132)
Bank Discount	(172)	Payee	(170)
Date of note	(170)	Principal	(166)
Days of grace	(170)	Proceeds	(172)
Instalment buying	(178)	Promissory note	(170)
Interest formula	(166)	Rate of interest	(169)
Maker	(170)	Semi-annually	(180)
Maturity date	(170)	Time note	(170)
Mortgage	(180)	Travellers' checks	(168)

Approximating the Answer

In the following examples, one of the numbers given is nearer to the correct answer than any of the other numbers. Estimate the answer and then select the number which is nearest the correct answer. Work the example to see if the number you chose is the nearest to the correct answer.

1. .76 × 158:	100, 125, 140, 85.
2. $\frac{16}{33}\frac{8}{2}$:	$\frac{2}{3}$, $\frac{1}{3}$, $\frac{1}{2}$, $\frac{3}{4}$.
3. 48.9 × 13.76:	50, 500, 60, 650.
4. 75.6 ÷ .495:	150, 1500, 1.5, 86.
5. 39,250 ÷ 1847:	20, 210, 50, 47.
6. 102% of 1637:	170, 1675, 16.75, 1620.
7. 492 is ?% of 1187:	250%, 4%, 18%, 40%.
8. 65 is 26% of:	260, 2600, 400, 750.
9. 4.8 is 9% of:	5, 50, 500, 37.5.
10. $\frac{1}{8}$% of 16,250:	2, 20, 200, 2030.
11. 176 is ?% of 8640:	5%, 20%, 25%, 2.3%.
12. .18 × 39.2:	72, 7.2, .72, 70.6.
13. .164 ÷ 3.2:	.5, .05, .005, .526.
14. 8.6 ÷ .12:	.7, 7, 70, 1.5.

Chapter Test

1. Using **a** = amount, **p** = principal, and **i** = interest, write the formula for finding the amount. What is the amount when the principal is \$750 and the interest is \$37.50?

2. If the amount is \$467.50 and the interest is \$17.50, what is the principal?

3. Find the interest on each of the following:

   a. \$600 at 5% for 1 yr.
   b. \$750 at 6% for $\frac{1}{2}$ yr.
   c. \$400 at 6% for 45 da.
   d. \$250 at 6% for 60 da.

4. At a rate of $\frac{3}{4}$%, find the fee charged for 8 travellers' checks of \$50 each.

5. The semi-annual interest on a loan of \$1000 was \$22.50. What was the rate?

6. The interest charged on a loan of \$500 for 90 days was \$6.25. What was the rate?

7. Find the proceeds on a promissory note of \$1200 for 90 days at 5%.

8. A loan is made on March 15 for 4 months. How many days are there in this period?

9. A television set has a price of \$320 cash or a time payment of 25% down and \$17.94 a month for 15 months. The cost on the instalment plan is how much more than the cash price?

10. Find the semi-annual interest on a mortgage of \$7500 at $4\frac{1}{2}$%.

11. Mr. Gaynor bought a house for \$10,500 and made a down payment of 20%. Then he secured a loan through N.H.A. for the unpaid balance. If the monthly payment on the loan was \$6.88 per \$1000, how much was each monthly payment?

12. If building costs today are 75% higher than they were 10 years ago, how much would it cost today to build a house that could have been built 10 years ago for \$6750?

13. At a rate of $\frac{1}{2}$% per month, find the interest on a loan of \$1250 for 2 months.

14. A rate of interest of $\frac{1}{2}$% a month is equal to what rate a year?

Progress Test in the Fundamentals

Work the following examples:

1. (48) .968 + .735 + .055 + .470

2. (8) $30{,}504 - 876$

3. (11) 678×508

4. (55) 37.5×8.6

5. (25) $9\frac{1}{5} - 7\frac{1}{2}$

6. (16) $74\overline{)43268}$

7. (16) $582\overline{)37462}$

8. (69) $.002\overline{)1}$

9. (29) $4\frac{1}{2} \times 3\frac{1}{3} \times 2\frac{3}{4} =$

10. (34) $\frac{5}{6} \div 1\frac{1}{2} =$

11. (34) $16 \div 2\frac{3}{4} =$

12. (69) $1.2\overline{)9}$

13. (71) $.15\overline{)7.5}$

14. (71) $5\overline{)13}$

15. (90) $\frac{7}{8} = ?\%$

16. (92) 3.2% of 780 =

17. (92) 103% of 480 =

18. (98) 9 = ?% of 50

19. (98) 175 = ?% of 125

20. (108) 36 = 4% of ?

If you did not understand how to work an example, turn to the page given in parentheses, where the step is explained.

★For Those Who Made No Error on the Above Test

You have learned to multiply two mixed numbers by changing each to an improper fraction and then multiplying.

1. We can find the product of $5\frac{3}{4}$ and $18\frac{2}{3}$ without changing each mixed number to an improper fraction, as shown below.

$$
\begin{array}{rl}
18\frac{2}{3} & \\
\times 5\frac{3}{4} & \\
\hline
90 & (5 \times 18) \\
3\frac{1}{3} & (5 \times \frac{2}{3}) \\
13\frac{1}{2} & (\frac{3}{4} \times 18) \\
\frac{1}{2} & (\frac{3}{4} \times \frac{2}{3}) \\
\hline
107\frac{1}{3} & \text{(Total)}
\end{array}
$$

a. Trace each step in the solution. Work out the problems in parentheses to show how the partial products were found. (How do we get these smaller problems?)

b. Check the example by changing the mixed numbers to improper fractions and then multiplying.

Use the method above to find the product of:

2. $6\frac{2}{3} \times 27\frac{1}{2}$

3. $5\frac{1}{3} \times 36\frac{3}{4}$

4. $4\frac{3}{4} \times 57\frac{1}{2}$

Test in Problem Solving

Solve the following problems. If you are unable to solve a problem, turn to the page indicated on the right.

1. In a recent year this country spent .5 billion dollars for new houses. If the average cost was $6,000 a house, how many houses were built that year? **(16)**

2. How many places to the right of ones' place is the place which represents ten thousandths? **(44)**

3. If a kilometer is equal to approximately $\frac{5}{8}$ mile, about what speed in kilometers is equal to a speed of 60 m.p.h.? **(79)**

4. A worker who received $1.20 an hour had a 10% increase in wages. How much would he then earn in a 40-hour week? **(92)**

5. A baseball pitcher has a record of 14 wins and 11 losses. What per cent of the games he pitched did he win? **(98)**

6. Mr. Watson sold his used car for $1350 which was 60% of the price he paid for it when new. How much did he pay for the new car? **(108)**

7. A circle has a diameter of 10 feet. The area of this circle is what per cent of the area of a square having a side of 10 feet? ($\pi = 3.14$) **(98)**

8. How many days are there from June 10 to September 20 of the same year? **(173)**

9. A finance company will make a loan of $200 to be paid back in 15 equal monthly instalments of $15.98. What is the interest charge on this loan? **(179)**

10. If the semi-annual interest on a mortgage of $2500 is $50, what is the rate of interest? **(169)**

TELLER

Annual income 20 pounds, annual expenditure 19 pounds, result happiness.

Annual income 20 pounds, annual expenditure 20 pounds 6 pence, result misery.

Adapted from "David Copperfield" by Charles Dickens.

CHAPTER VI

School Savings

1. State in your own words what the quotation from Dickens means.

One of the most common ways of saving money is to have a savings account in a **savings bank**. A savings bank does not permit its depositors to draw checks on savings accounts. Most commercial banks have a savings department.

The picture on page 190 shows Johnnie who has just made his first deposit in a savings bank. At the bottom of this page is an enlargement of the passbook he is holding.

2. In public and private schools in one of the large cities in this country, there are approximately 200,000 pupils who have savings accounts. Their deposits amount to about 6 million dollars. To the nearest dollar, what is the average amount of each account?

3. Do you have a school savings bank in your school? What day of the week is "bank day"? Is there a limit placed on the amount you may deposit each week?

4. If you save an average of 5¢ a day, how much would you be able to save in a school year of 36 weeks, counting 5 days a week?

★5. What is done with the money that is collected in school banks?

Savings Banks Pay Interest

Savings banks usually pay interest to their depositors semi-annually. All banks do not pay the same rate of interest. The rate varies from 1% to 3% a year.

1. What rate of interest does the Valley Savings Bank pay? What is the semi-annual rate?

2. Find the semi-annual interest on each of the following deposits:

a. \$450 at 2%
b. \$760 at 1%
c. \$940 at $1\frac{1}{2}$%
d. \$1280 at $2\frac{1}{2}$%
e. \$2150 at 2%
f. \$3280 at $1\frac{1}{2}$%

3. A few savings banks pay interest **quarterly** (four times a year). A rate of 2% a year is equal to what quarterly rate?

4. Find the quarterly interest on a deposit of \$1560 at a rate of 2% a year.

Many banks do not pay interest on a deposit made during the interest period. If money is withdrawn from an account during an interest period, interest is paid on the smallest amount on deposit during that time.

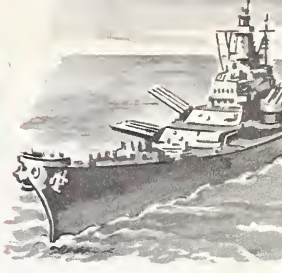
5. At a rate of 2%, find the semi-annual interest on the following: On deposit July 1, \$1486; Aug. 15, withdrawn \$250; Sept. 30, deposited \$100; Nov. 1, deposited \$200.

\$1486 − \$250 = \$1236, principal on which interest is paid.
\$1236 + \$100 + \$200 = \$1536, balance at end of year.

Find the semi-annual interest on \$1236 at a rate of 2% a year.

6. At a rate of 2%, find the semi-annual interest on the following:

a. On deposit Jan. 1, \$1936; Feb. 1, deposited \$375; Mar. 1, deposited \$180; May 4, withdrawn \$500.
b. On deposit July 1, \$2345; Aug. 10, deposited \$125; Sept. 1, withdrawn \$300; Nov. 1, deposited \$250.



How Savings Banks Earn Money

A savings bank gets the money to pay interest to its depositors in various ways. One way is to make loans at higher rates than it pays to its depositors.

1. The picture on the left shows a house on which there is a mortgage. What is a mortgage? A savings bank has lent $250,000, secured by mortgages. At an average of $4\frac{1}{2}\%$, what is the yearly income from this source?

2. The transportation company shown in the second picture needs new equipment. It issues **bonds** which are pledges to repay the money borrowed and to pay a fixed rate of interest. A savings bank invests part of the deposits in bonds which have a face value of $375,000. If the bonds pay $3\frac{1}{2}\%$ interest, what is the yearly income from this source?

3. The third picture shows that our government must spend money for our national defense. The government issues bonds which savings banks buy. If a savings bank purchases government bonds which have a face value of $950,000 and the bonds pay 2.45% interest, what is the yearly income from this source?

4. Most vaults contain **safety deposit boxes** which are for rent. One bank has 450 boxes, each of which rents at $5 a year, and 125 boxes, each of which rents at $10 a year. If 80% of each kind of box are rented, what would be the yearly income from these rentals?

5. During a year Mr. Hartwell buys the following travellers' checks at a savings bank: Sixty $10's; ninety $20's; one hundred and thirty $50's; forty-two $100's. What would be the fee from the sale of these checks? (See page 168.)

★**6.** Find out other ways in which savings banks make money.

Compound Interest

When his son was born, Mr. Lind deposited $700 in a savings bank in his son's name. The money was to be used for the boy's education. The father knew that in 18 years the $700 plus interest would be approximately equal to $1000.

At the end of each year, the interest on young Lind's account was added to the principal. The money in his account drew **compound interest.** This means that interest was paid on the interest that was added to the principal at the end of each year as well as on the original principal. Each year the sum on which interest was paid was larger than the previous year and so each year the interest added was larger.

1. Find the simple interest on $700 at 2% for 1 year; for 18 years.

2. In the account which Mr. Lind had for his son, the interest on the principal of $700 was 2% **compounded annually.** This means that the interest was added to the principal yearly. If the amount at the end of 18 years was $1000, what was the total compound interest for the 18-year period? This amount was how much more than the amount would have been at simple interest at the same rate and for the same time? (See problem 1.)

The rate of interest in savings banks is seldom more than $1\frac{1}{2}\%$ or 2%. When the rate is 4% or more, the difference between simple interest and compound interest (on the same principal) can be seen more readily than when the rate is lower.

3. What is the simple interest on $100 at 4% for 3 years?

4. Does the principal change or remain the same when it is loaned at simple interest?

5. Does the principal change or remain the same when deposited in a savings account at compound interest?

6. How many times a year is the interest added to the principal when the interest is compounded annually? when the interest is compounded semiannually?

7. What is the amount (principal plus interest) of $100 at 4% at the end of 3 years if the interest is compounded semi-annually.

$100.00, original principal
4.00, int. at end of 1 yr.
$104.00, prin. at end of 1 yr.
4.16, int. at end of 2 yr.
$108.16, prin. at end of 2 yr.
4.32, int. at end of 3 yr.
$112.48, prin. at end of 3 yr.

a. What is the interest at the end of 1 yr.? at the end of 2 yr.? at the end of 3 yr.?

b. Interest is not paid on part of a dollar. What would be the compound interest at 4% at the end of the fourth year?

c. What would be the amount at the end of the fourth year?

8. Compound interest on $100 at 4% for 3 years compounded annually is how much more than simple interest on the same principal at the same rate for the same period of time?

9. A rate of 4% is equal to what semi-annual rate?

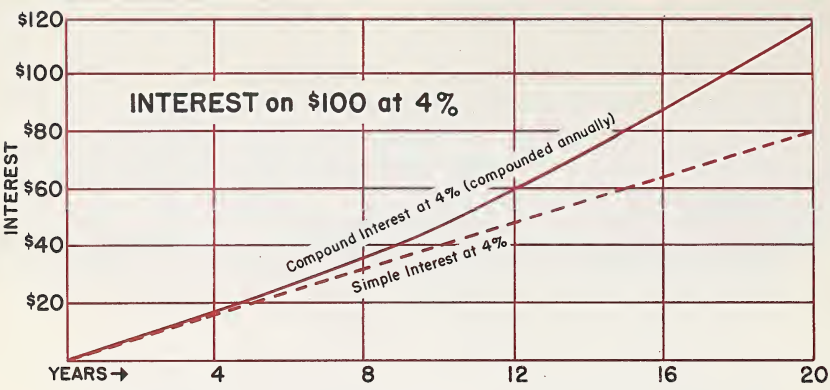
10. Solve problem 8 if the interest is compounded semi-annually. (A rate of 4% for 1 year is equal to a semi-annual rate of 2%.) Show that the amount at the end of the second year is $108.24 and at the end of the third year, $112.60. How much more is this than when compounded annually? than simple interest?

11. If the interest is compounded annually, find the amount of each of the following:

a. $200 at 2% for 3 yr.
b. $450 at 3% for 2 yr.
c. $750 at 4% for 3 yr.
d. $500 at 2% for 4 yr.

12. In each example in problem 11, how much more does the money amount to if placed at compound interest than it does if placed at simple interest?

★13. If the interest on $100 at 4% is compounded quarterly, would the amount at the end of 3 years be equal to, more than, or less than the amount if the interest is compounded semi-annually? Why?



Simple and Compound Interest Compared

The graph shows the interest on \$100 at 4% for 20 years if the interest is compounded yearly and also shows the interest on the same principal at the same rate for 20 years at simple interest.

1. What do the numbers along the horizontal scale represent? What do the numbers along the vertical scale represent?

2. From the graph, approximately what is the compound interest on \$100 at 4% at the end of 4 yr.? at the end of 8 yr.? at the end of 16 yr.?

3. In problem 2, when the time was doubled, was the interest also doubled? more than doubled? less than doubled?

4. From the graph, read the approximate simple interest on \$100 at 4% at the end of 4 yr.; at the end of 8 yr.; at the end of 16 yr.

5. From problem 4, if we double the time do we double, more than double, or less than double, the simple interest?

6. Use the graph to find approximately what the amount of \$100 at 4% compounded annually would be at the end of 5 yr.; at the end of 10 yr.; at the end of 15 yr.; at the end of 20 yr.

7. From the graph, approximately what would be the amount of \$500 at the end of 12 years if compounded annually at 4%?

★8. From the graph, tell approximately how many years it takes money to double itself, when interest is compounded annually at 4%. When money at interest doubles itself, how do principal and interest compare?

Bettmann Archive

The Magic of Compound Interest

The picture shows New Amsterdam about 1650. History records that Manhattan Island was purchased by the Dutch from the Indians in 1626 for 60 guilders, or for about $24.

1. How many years was it from the date of purchase of Manhattan to 1950?

2. What would be the interest on the purchase price of Manhattan at 6% for 1 year?

3. If $24 had been invested at simple interest at 6% from 1626 to 1950, what would the total interest have been? What would the amount have been?

4. In 1950 it was estimated that New York City was worth 1000 million times the purchase price of Manhattan Island. Write 1000 million with figures. What was the value of New York City in 1950?

5. Compound interest works as if by magic. If $24 were invested at 6%, compounded annually from 1626 to 1950, the amount at the end of the 324 years would be about $3,780,000,000. This amount is how much less than the estimated value of the city in 1950?

6. If $24 were invested at 6.1% interest, compounded annually, in 1626, the amount in 1950 would have been about $5,090,000,000. This is how much more than the amount at 6%?

★7. Money at 6% interest, compounded annually, doubles itself about every 12 years. If the amount in 1950 of $24 at 6% interest compounded annually was $3,780,000,000, what would be the amount at the same rate 24 years later, or in 1974?

Reviewing Formulas

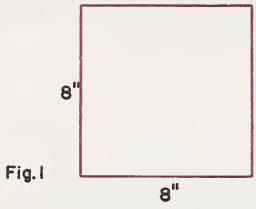


Fig. 1

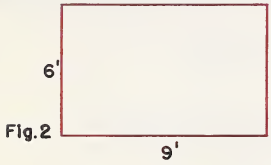


Fig. 2

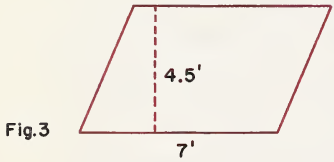


Fig. 3

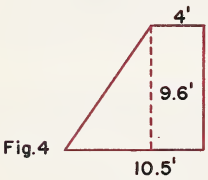


Fig. 4

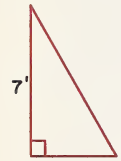


Fig. 5

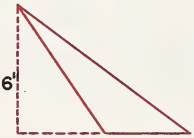


Fig. 6

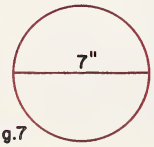


Fig. 7

1. Write the formula for finding the perimeter of Fig. 1; for finding the area.

2. What is the perimeter of Fig. 1? What is the area?

3. Write the formula for finding the perimeter of Fig. 2; for finding the area.

4. What is the perimeter of Fig. 2? What is the area of this figure?

5. Write the formula for finding the area of Fig. 3. What is the area of this figure?

6. Write the formula for finding the area of Fig. 4. What is the area of this figure?

7. What kind of triangle is shown in Fig. 5? What kind of triangle is Fig. 6?

8. What is the area of Fig. 5? the area of Fig. 6?

9. Each of the two equal sides of an isosceles triangle is 8 inches. If the perimeter is 20 inches, what is the base of the triangle?

10. Write the formula for finding the circumference of a circle. Find the circumference of Fig. 7. ($\pi = 3\frac{1}{7}$)

11. Write the formula for finding the area of Fig. 7. Find the area of this figure. ($\pi = 3\frac{1}{7}$)

12. One part of a circle graph has a central angle of 60°. What part of the circle does this angle occupy?

Practise What You Have Learned

1. $\begin{array}{r} 746 \\ 938 \\ 57 \\ 1439 \\ 604 \\ 85 \\ \hline \end{array}$

2. $\begin{array}{r} 2\frac{1}{3} \\ 4\frac{1}{2} \\ 7\frac{3}{4} \\ 9\frac{5}{6} \\ \hline \end{array}$

3. $\begin{array}{r} 758 \\ \times 49 \\ \hline \end{array}$

4. $\begin{array}{r} .95 \\ \times 2.7 \\ \hline \end{array}$

5. $\begin{array}{r} 17\frac{3}{4} \\ -9\frac{7}{8} \\ \hline \end{array}$

6. $17\overline{)5274}$

7. $9\overline{)1.35}$

8. $.4\overline{).17}$

9. $2\frac{1}{3} \times \frac{5}{6} =$

10. $4\frac{2}{3} \times 3\frac{1}{7} \times \frac{5}{6} =$

11. $\frac{7}{8} \div 2\frac{1}{4} =$

12. $\frac{3}{8} = ?\%$

13. 102% of $480 =$

14. $\frac{1}{4}\%$ of $1760 =$

15. $12 = ?\%$ of 80

16. $37 = ?\%$ of 25

17. $40 = 8\%$ of ?

18. 250% of $? = 750$

19. 3.4% of $180 =$

20. $1 = ?\%$ of 200

Number Quickies

1. An inch of rainfall is equal to 10 in. of snow. How much rainfall is equal to 17.5 in. of snow?

2. If a metric ton is approximately 2200 lb., about what per cent greater is it than a standard ton?

3. Eighty per cent of the corn raised in this country is fed to livestock and poultry. At that rate, if a farmer raised 2600 bu. of corn, how many bushels would be used for feeding livestock and poultry?

4. A loan of $100 may be paid off in 6 equal monthly instalments of $18.08 each. What is the interest charge for the loan?

5. Find the cost of 1000 gal. of fuel oil at 18¢ a gallon paid for in cash if a discount of 2% is given for cash.

6. If the interest on a loan of $1000 for 6 mo. is $25, what is the rate of interest?

7. An interest rate of 6% a year is equal to what rate a month?

8. A test contains 40 questions and it is to be marked in per cent. One question represents what per cent of the total?

9. The weight of a child at the end of 1 year is usually three times its weight at birth. What is the per cent of increase in its weight?

CANADA SAVINGS BONDS

Millions of dollars of savings bonds have been sold and are being sold by our Dominion Government to pay for the cost of World War II and other important government projects. A recent issue, called Series 8 was issued in denominations of $50, $100, $500, $1000, and $5000. No individual may purchase more than $5000. The **term** of the bonds is 12 years, and the coupon rate is $3\frac{3}{4}\%$ per annum.

1. Series 8 bonds were issued on Nov. 1 1953. What is the date of maturity of this series?

2. Canada Savings bonds are **redeemable** at any branch in Canada of any chartered bank, at **par plus accrued interest** (on a monthly basis). Explain the words in bold face type.

3. The following table shows the **redemption value** of Series 8 Canada Savings bonds of various denominations for each month after the issue date.

Month	$50.00	$100.00	$500.00	$1000.00	$5000.00
Nov.	50.00	100.00	500.00	1000.00	5000.00
Dec.	50.16				
Jan.	50.31				
Feb.	50.47				
Mar.	50.63				
Apr.	50.78				
May	50.94				
June	51.09				
July	51.25				
Aug.	51.41				
Sept.	51.46				
Oct.	$51.72	$103.44	$517.19	$1034.38	$5171.88

Fill in the blanks in the table.

4. Mr. Donald bought three $500 and two $100 Canada Savings bonds on Nov. 1, 1953. On Jan. 2, 1957, if he has clipped all his coupons, How much would he receive for the bonds?

5. How much would Mr. Donald (question 4) have received from the coupons he had clipped during the period he had held the bonds?

Canada Savings Bonds Are A Good Investment

The table shows certain facts about the first eight series of Canada Savings bonds.

Series No.	Date of Issue	Term	Coupon Rate	Amount Sold
1	Nov. 1, 1946	10 yrs.	$2\frac{3}{4}\%$	$535,286,000
2	Nov. 1, 1947	10 yrs.	$2\frac{3}{4}\%$	287,733,000
3	Nov. 1, 1948	10 yrs.	$2\frac{3}{4}\%$	260,491,000
4	Nov. 1, 1949	10 yrs.	$2\frac{3}{4}\%$	320,200,000
5	Nov. 1, 1950	10 yrs.	$2\frac{3}{4}\%$	285,000,000
6	Nov. 1, 1951	$10\frac{3}{4}$ yrs.	$3\frac{1}{2}\%$	362,200,000
7	Nov. 1, 1952	$10\frac{3}{4}$ yrs.	$3\frac{3}{4}\%$	380,000,000
8	Nov. 1, 1953	12 yrs.	$3\frac{3}{4}\%$	875,000,000

1. Find the maturity date of each series.

2. Compute the annual interest on each issue (if there are no redemptions).

3. How much more would the annual interest be on a Series 8 bond for $1000 than on a Series 5 bond for the same amount?

4. Mr. Dunlop holds a Series 1 Canada Savings bond for $2000 bought at date of issue. What is the value of his bond at the date of issue of Series 8 provided he has cashed all his coupons as they came due?

5. What value of additional bonds could Mr. Dunlop (question 4) have purchased had he saved all the interest he earned on his Series 1 bond? What denominations could he purchase? How much cash would he have left?

★**6.** Canada Savings bonds may be purchased from a bank on an instalment plan, or on a pay-roll savings plan. Find out about both these methods from an appropriate source.

Savings Stamps

The picture shows Tom with his book of savings stamps. No interest is paid on these stamps, but they may be converted to Savings Bonds when a book is filled with stamps. Then the savings begin to draw interest. Savings stamps may be purchased in units of 10¢, 25¢, 50¢, $1.00, and $5.00. A book of 10¢ and 25¢ stamps may be converted to a $25 bond; a book of 50¢ stamps may be converted to a $50 bond; a book of $1 and $5 stamps may be converted to a $100 bond.

1. How many 25 cent stamps does it take to buy a $25 bond?

2. How many 50 cent stamps does it take to buy a $50 bond?

3. How many $1 stamps does it take to buy a $100 bond? How many $5 stamps does it take to buy a $100 bond?

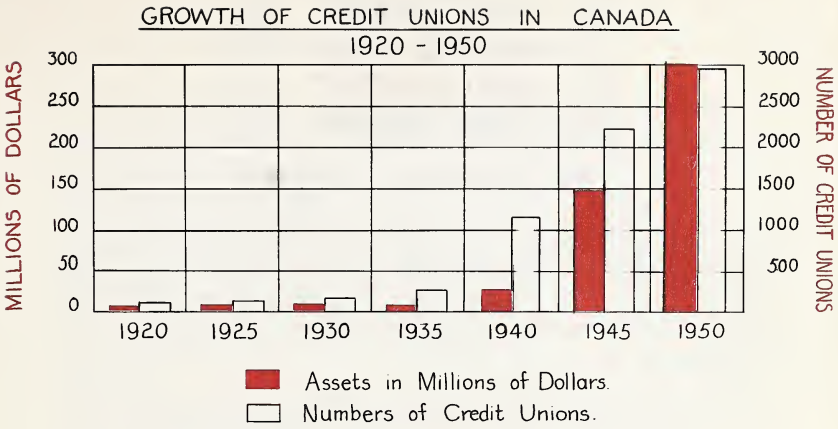
The table on the right shows how savings grow by converting them into Savings Bonds as soon as possible.

Save	Buy Bonds and You Will Have		
Each Week	In 1 Year	In 5 Years	In 10 Years
$0.10	$5.20	$26.12	$54.75
.25	13.00	66.37	141.87
.50	26.00	133.24	285.99
.75	39.00	200.74	431.49
1.00	52.00	267.23	574.61
1.25	65.00	334.11	719.11
1.50	78.00	401.48	863.98
2.50	130.00	668.97	1,440.84

4. Use the table to find how much money may be accumulated by saving 10¢ a week for 5 yr.; for 10 yr.

5. Allowing 52 weeks to a year in problem 4, the accumulation is how much more than the principal?

6. From the table, is the accumulation of $1.00 a week for 5 years 10 times the accumulation of 10¢ a week for 5 years? Is the accumulation of $1.00 a week for 10 years 10 times the accumulation of 10¢ a week for 10 years?



Growth of Credit Unions in Canada

Credit Unions exist to provide people with a convenient place to deposit savings and also as a source of short-term credit for emergencies and for approved business or personal ventures. The graph shows the growth of total assets and the number of Credit Unions in Canada for the period indicated.

1. In what year did the growth of Credit Unions become noticably rapid? What event in world history may be associated with this growth?

2. Reading from the graph, what were the total Assets in 1935? In 1950?

3. What was the approximate number of Credit Unions in 1935? In 1950?

4. The total assets in 1950 was how many times the total assets in 1935? Give your answer to the nearest whole number. What percent of growth is this?

5. The total number of Credit Unions in 1950 was how many times the total number in 1935? Give the answer to the nearest whole number. What per cent of growth was this?

★6. Find out if there is a Credit Union in your locality. Prepare a report for your class in its activities.

MORE PRACTICE

The Scout Boat Company

A group of 20 Boy Scouts decided that they could make money during the summer if they had boats to rent on Crystal Lake. The Scouts found that they would need at least $100 to buy used boats and to buy paint and other supplies to put their own boats in good condition.

The Scouts then decided to form a **stock company.** Each boy had to buy at least 5 **shares of stock** at $1 a share. The **par value** or face value of the stock was $1. The illustration shows a mimeographed copy of a **stock certificate.** The money which the boys received from the sale of the stock formed the **capital** of the company. They used this money to buy the boats and supplies.

1. If the Scouts issued 125 shares of stock, what was the average number of shares of stock bought by each Scout?

2. If one Scout bought 10 shares of stock, what per cent of the total number of shares did he own? (See problem 1.)

3. The profit for the first month of operation of the company was $35. The **stockholders** (owners of stock) declared a **dividend** of 10¢ a share. Each stockholder received 10¢ for each share of stock he owned. The dividend was what per cent of the cost of a share?

4. The profits which remained after paying dividends were put into a fund called **surplus.** From problem 3, how much of the profits were put aside as surplus? How will the value of the stock be affected as the surplus increases?

5. After the company was in operation for 6 weeks, one of the Scouts sold his 5 shares of stock to another stockholder for $6. For how much above par value or below par value did he sell each share of stock?

★6. In case the value of stock decreases, who has to take the loss? In case the value of stock increases, who gains as a result?

Forming a Corporation

A company that manufactures automobiles or other things is called a **corporation**. The province in which a corporation is organized grants the corporation a **charter**. This charter gives the corporation certain rights to carry on business in that province.

A corporation issues stock. The stockholders elect officers who operate the company. Every stockholder shares in the earnings of the company according to the number of shares of stock he owns.

1. A corporation issued half a million shares of stock which were sold at $100 a share. How much did it receive from the sale of stock?

2. In problem **1**, how much must a stockholder invest to own 1% of the stock?

3. One out of each 25 families in this country owns stock in our largest corporation. If there are 4 million families in this country, how many families own stock in this company?

4. At a recent date, a company which manufactures automobiles had 435,000 stockholders. The number of shares owned by stockholders was distributed as follows:

34% owned 1 to 20 shares
19% owned 51 to 100 shares
26% owned 21 to 50 shares
13% owned 101 to 200 shares
8% owned 201 or more shares

Show these facts by a circle graph.

5. In problem **4**, the average stockholder owned 68 shares of stock of the company. Find the number of shares in this corporation.

6. A corporation pays a quarterly dividend (4 times a year) of 75¢ a share. Find the yearly dividend of a stockholder who owns 20 shares of the stock; who owns 75 shares of the stock.

★**7.** What is meant by a stock dividend? Who pays the dividend? Who receives it?

★**8.** A man paid $50 for a share of stock which paid a quarterly dividend of $1. The yearly dividend was what per cent of the purchase price of the stock?

Trading Floor of Toronto Stock Exchange

Market Value of Stocks

The Toronto Stock Exchange had the largest value of trading on the North American continent in 1953. Over 800,000,000 shares were traded during the year. The value of these, representing over 72% of all Canadian Securities traded, was over a billion dollars. When a buyer and a seller agree on an acceptable price, a sale is made. The price at which stock can be bought is its **market value**. The record, taken from a daily newspaper, of the sales of a few stocks made one day in a recent year is given in the table below:

Sales	Name of Stock	Open	High	Low
200	Cdn. Pac. Rly.	$23\frac{5}{8}$	$23\frac{3}{4}$	$23\frac{1}{4}$
700	Imp. Oil	$(29\frac{1}{8})$	$29\frac{1}{4}$	29
800	B.C. Power	$17\frac{7}{8}$	$18\frac{3}{8}$	18

The numbers given to the right of the name of a stock represent the **cost in dollars for one share.** The term "open" refers to the price of a stock at the opening of the Exchange that day. For the day given, the opening price of Canadian Pacific Railway was $23\frac{5}{8}$. The terms "high" and "low" refer to the highest and lowest prices of a share of stock during that day.

1. How many shares of stock of Canadian Pacific Railway were sold? of Imperial Oil? of British Columbia Power?

2. What was the opening price of one share of Imperial Oil? What was the highest price paid? What was the lowest price paid?

3. Find the market value of 100 shares of each of the three stocks at the high value; at the low value.

4. Find the market value of 100 shares of stock quoted as follows:

a. $9\frac{1}{4}$ b. $17\frac{3}{4}$ c. $46\frac{1}{2}$ d. $80\frac{1}{4}$ e. $147\frac{3}{4}$

Buying and Selling Stock

Much stock is bought and sold at a broker's office. **Brokers** are dealers who buy and sell stock. A broker receives a commission or fee for his services. This fee is called a **brokerage**. The rate of commission depends upon the market value of the stock.

The following table shows the brokerage on certain values of stocks charged by Canadian brokers.

On shares under 50¢ the brokerage is 1 cent per share.

On shares from 50¢ to 99¢ the brokerage is 2 cents per share.

Value of Share	Brokerage in cents per share	Value of Share	Brokerage in cents per share
Under 50 cents	1	from $ 15.00 to $ 24.99	30
from 50 cents to 99 cents	2	25.00 to 39.99	35
$ 1.00 to $ 1.99	4	40.00 to 59.99	40
2.00 to 2.99	6	60.00 to 79.99	45
3.00 to 3.99	8	80.00 to 99.99	50
4.00 to 4.99	10	100.00 to 109.99	55
5.00 to 7.49	15	110.00 to 119.99	60
7.50 to 9.99	20		
10.99 to 14.99	25	$120.00 and over	½% of Selling Price

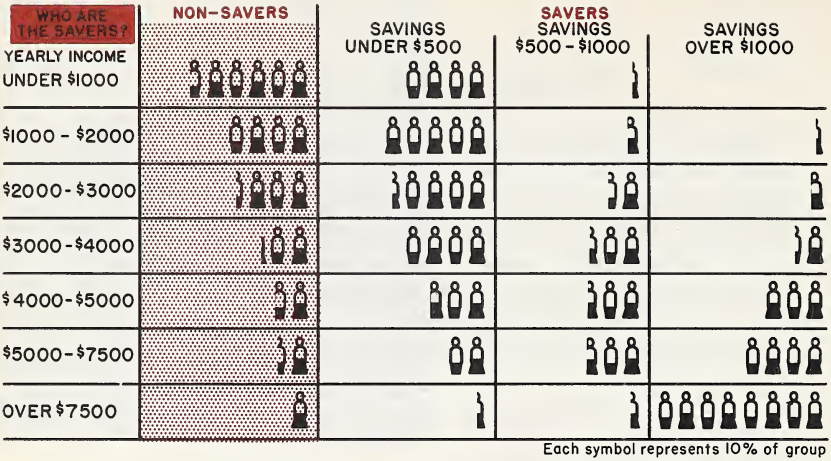
1. Find the commission on 100 shares of stock selling at 4; at $2\frac{1}{2}$; at $9\frac{1}{4}$; at $3\frac{3}{4}$.

2. Find the cost, including brokerage, of 100 shares of stock sold at 40; $63\frac{1}{4}$; 115; $126\frac{1}{2}$.

3. A broker sold 1000 shares of stock at 25 cents. What was his commission and what was the total cost to the purchaser.

4. A man bought 100 shares of stock at $3\frac{3}{4}$. He sold them the following week at $4\frac{1}{4}$. Did he gain or lose on the transaction? How much?

★5. Find the loss or gain on the following transaction: 100 shares of stock bought at $119\frac{1}{2}$ and sold one week later at 120.



The People Who Save

The graph shows the number of people who saved part of their income in a recent year.

1. How many different income groups are shown?

2. Each symbol on the graph represents what per cent of the people within a given income group?

3. Approximately what per cent of the group having an income of less than $1000 had no savings?

4. Approximately what per cent of the group having an income of more than $7500 had no savings? About what per cent of this group had savings of more than $1000?

5. If the income was $7500 and the savings were $1000, what per cent of the income was saved?

6. For the income group of $4000–$5000, approximately what per cent saved $500 or more per year?

7. If the average income of the group in problem 6 was $4400 and the average savings of this group were $600, what per cent of income, to the nearest per cent, was saved?

★8. How do costs of commodities affect the amount of savings?

★9. How do costs of commodities affect the number of articles which may be purchased by savings?

Practise What You Have Learned

1. .456 / .938 / .470 / .625

2. $7\frac{1}{2}$ / $2\frac{3}{4}$ / $9\frac{5}{8}$

3. 61432 − 978

4. 870 × 580

5. $9\frac{3}{4} - 2\frac{5}{6}$

6. $180\overline{)91432}$

7. $.6\overline{)45}$

8. $.04\overline{)7.5}$

9. $12 \times \frac{3}{8} =$

10. $16 \div \frac{2}{3} =$

11. $7\frac{1}{2} \div 3\frac{1}{4} =$

12. $1\frac{1}{2} \times \frac{7}{8} =$

13. $\frac{5}{6} = ?\%$

14. $\frac{1}{2}\%$ of $920 =$

15. $5 = ?\%$ of 40

16. $4 = 2\%$ of ?

17. 103% of 570 =

18. 27 = ?% of 18

19. 36 = 5% of ?

20. 4 ft. 9 in. / 3 ft. 7 in. / 10 in.

21. 4 yd. 15 in. − 2 yd. 27 in.

22. 3 hr. 28 min. × 3

23. $4\overline{)15 \text{ min. } 30 \text{ sec.}}$

24. $\frac{7}{8}$ to the nearest hundredth =

25. Without copying, find the sum of:

$$736 + 925 + 48 + 609 + 1138 + 461$$

Approximating the Answer

Use approximation to estimate the answer in each example. Then select the one of the four numbers given which you think is nearest to the correct answer. See if your selection was correct by working the example.

1. 38.4 ÷ 2.6: 14, 143, 1.4, 19.
2. 58.2 × 3.14: 150, 180, 17.94, 210.
3. $\frac{1}{4}\%$ of 34,780: 350, 300, 85, 850.
4. 112% of 1654: 170, 3000, 2700, 1800.
5. 407 is 24% of ?: 160, 1600, 280, 2800.
6. $\frac{736}{2210}$: $\frac{1}{4}, \frac{1}{5}, \frac{1}{3}, \frac{1}{2}$.
7. 73 ÷ .068: 100, 1000, 10,000, 935.
8. 1712 is ?% of 843: 50%, 60%, 25%, 200%.
9. 6.54 is ?% of 32.5: 500%, 50%, 20%, 2%.
10. 1971 is 150% of ?: 1000, 2000, 1300, 650.

Insuring Against Loss

The students of the Fraser School had to pay for school books they lost or mislaid. To protect themselves against this loss, the students of one class formed an **insurance club** to share the losses.

1. There were two books lost in a class during the first month. If the value of each book was $1.25 and there were 25 members in the class, what was the average loss for each student?

2. On the basis of the average loss during the first month, the class decided to charge each student 10¢ a month for 9 months. This charge was called the insurance **premium.** If Sam lost a book worth $1.75, how much cheaper would it have been for him to have paid the insurance premium for the 9 months than to have paid the cost of the book?

3. What might happen which would make it necessary to increase the premium? What might happen which would make it possible to decrease the premium?

4. When there was money left in the club treasury at the end of the year, the club declared a **dividend.** What are some of the things which would affect the size of the dividend?

5. Ethel said, "I never lose a book, so I don't think I should belong to the insurance club." Give reasons why you do or do not agree with her.

6. Insurance is a means of sharing losses due to some **risk** involved. State some of the risks involved in leaving your books in your desk overnight; in taking your books home overnight.

★7. If you ride a bicycle to school, what are some of the risks you take when you ride it or when you park it at school? How can some of the risks be reduced?

Fire Insurance

In the same way as the students in the Fraser School formed a club to share the risk of loss of books, so large insurance companies have been formed to share the risk of loss of property by fire.

Fire insurance companies charge a yearly premium for the risk assumed. The written contract between the company and the owner of the property is called the **policy.** The amount of the insurance is the **face of the policy.**

1. How does having a fire department in a city affect the risk of loss of property by fire?

2. When there is a volunteer fire department in a village, the risk of loss of property by fire is greater than when there is a paid fire department. Why?

3. As the risk increases, how is the yearly premium affected?

The yearly premium per $100 of fire insurance in a certain city is as follows:

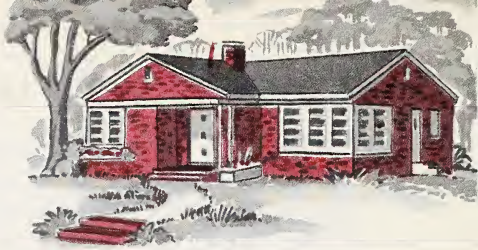
Kind of Building	Wood Shingle Roof	Approved Roof
Brick Dwelling	22¢	18¢
Frame Dwelling	31¢	27¢
Brick Apartment	46¢	42¢
Frame Apartment	54¢	49¢

4. Find the yearly premium on a policy of $4500 on a brick dwelling with an approved roof.

The rate is 18¢ per $100 of insurance.
The premium is 45 × 18¢ = ?
Why is 18¢ multiplied by 45 and not by 4500?

5. Find the yearly premium on each of the following:

Building	Roof	Policy
a. Brick dwl.	Wd. shingle	$2700
b. Frame apt.	Approved	$3750
c. Brick apt.	Approved	$35,000
d. Frame apt.	Approved	$17,500



Fire Insurance Premiums Vary in Costs

The amount of the yearly premium, for fire insurance, depends upon the following:

a. Type of structure
b. Location of the structure
c. Surroundings
d. Use of the structure

1. On which of the two houses shown should the yearly premium per $100 be the smaller? Why?

2. Why is the premium per $100 for an apartment house higher than for a single dwelling?

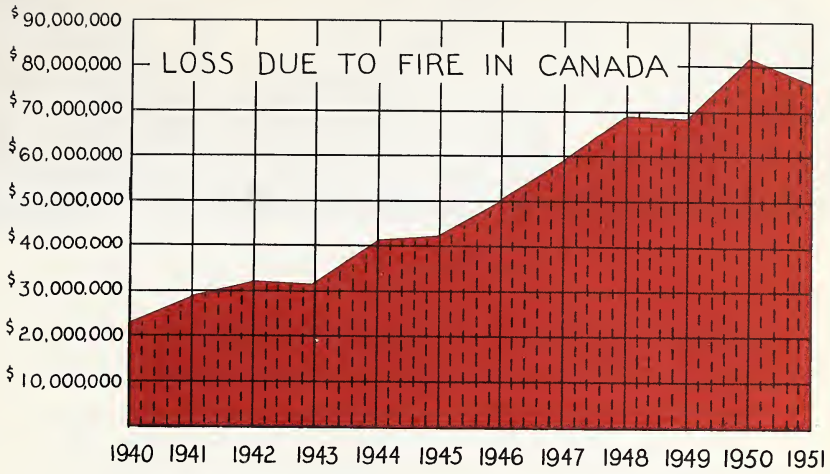
The rate for fire insurance depends upon the length of time of the policy. The table shows the rates for different periods of time:

Period	Rate
2 years	$1\frac{3}{4}$ times the rate for 1 year
3 years	$2\frac{1}{2}$ times the rate for 1 year
4 years	$3\frac{1}{4}$ times the rate for 1 year
5 years	4 times the rate for 1 year

3. What per cent of the cost of 5 one-year policies on a house may be saved by buying one 5-year policy?

4. Find the premium on the following at rates given above.

	Yearly Rate per $100	Face of Policy	Time of Policy		Yearly Rate per $100	Face of Policy	Time of Policy
a.	18¢	$4800	3 yr.	d.	44¢	$36,500	3 yr.
b.	26¢	$6800	4 yr.	e.	51¢	$54,000	4 yr.
c.	16¢	$3450	2 yr.	f.	57¢	$17,400	1 yr.



Fire Losses in Canada

1. Approximately what was the amount of loss due to fire in Canada in 1941? in 1948? in 1951?

2. In which year shown was the loss due to fire the greatest? Approximately what was the loss in that year?

3. In which year shown was the loss due to fire the least? Approximately what was the loss in that year?

4. During which year in World War II shown on the graph was the loss due to fire the greatest? Approximately what was the loss in that year?

5. In a recent year the loss due to fire was approximately $81,525,000. The population of Canada was approximately 14,000,000. About how many dollars was the average loss for a person (loss **per capita**) that year?

6. Fire losses increase as industrial activity increases. What can you infer from the graph as regards this statement?

★7. Why are there likely to be greater loses from fire during a period of great industrial activity than during a period of low industrial activity?

★8. How does the total amount of loss due to fire in a given community affect the rates for fire insurance?

Automobile Insurance

The picture shows how property may be damaged or destroyed by an automobile. In the same way life may be lost by any accident.

In case of an accident by a car, the owner causing the accident is held responsible for the damage done. For that reason many owners of cars protect themselves against the risk of accident by purchasing automobile insurance of different kinds. **Liability insurance** protects the owner against claims due to injury by his car of persons in or out of his car. A standard form of insurance is a policy for \$5000–\$10,000–\$5000. This policy makes the insurance company responsible for claims for personal injury up to \$5000 for one person and up to \$10,000 for injury to two or more persons and for property damage up to \$5000.

1. A car which is insured for \$5000–\$10,000 liability insurance injures 2 persons. If each of the injured collects \$7500 in damages, how much must the owner of the car pay? How much must the company pay?

2. In problem **1**, if each of the injured collects \$2500 in damages, how much must the owner of the car pay? How much must the company pay?

3. The cost of a policy of \$5000–\$10,000–\$5000 in a certain city is distributed as follows: Liability insurance, \$32; property damage, \$18. The cost of each is what per cent of the cost of the total premium?

4. For 15% more than the cost of the yearly premium in problem **3**, the amount of the insurance may be doubled. What is the cost of \$10,000–\$20,000 liability insurance? What is the cost of \$10,000 property damage insurance?

5. Some insurance companies will allow a driver who has had no accidents during a year to pay only 90% of the regular premium as his premium for the next year. Find the regular premium if the reduced premium is \$45; \$37.80; \$29.70; \$57.87.

6. A car may be insured against loss by fire or theft. In a certain city the cost per \$100 for fire insurance is 32¢ and for theft, 44¢. Find the total cost of fire and theft insurance on a car insured for \$2400; for \$1800; for \$1250.

7. Why is the premium on a policy for liability and property damage more for a car registered in the city than for one registered in the country?

8. Why should the insurance premium for commercial cars and trucks be more than for private passenger cars?

9. Why should the rate for fire insurance be less on a new car than on a used car?

★10. In some provinces the premium on an insurance policy for liability and property damage on a car is more when a driver of the car is under 25 years of age than when he is 25 years of age or over. Give a reason why.

★11. Find out why it is possible to double the amount of an insurance policy for liability and property damage without doubling the yearly premium.

★12. Some provinces compel the owner of a car to have his car insured for liability and property damage. Discuss the advantages and disadvantages of this plan.

Practise What You Have Learned

1. $\begin{array}{r} 9.75 \\ 3.49 \\ 6.58 \\ 1.67 \\ \underline{8.06} \end{array}$

2. $\begin{array}{r} 7005 \\ \underline{-8} \end{array}$

3. $\begin{array}{r} 506 \\ \underline{\times 309} \end{array}$

4. $\begin{array}{r} 82 \\ \underline{\times 9\frac{3}{4}} \end{array}$

5. $\begin{array}{r} 16\frac{2}{3} \\ \underline{-9\frac{3}{4}} \end{array}$

6. $36\overline{)1476}$

7. $275\overline{)11434}$

8. $.05\overline{)11}$

9. $\frac{5}{6}$ of 175 =

10. $6 \div \frac{5}{6} =$

11. $3\frac{1}{7} \times 3\frac{1}{2} \times 5\frac{3}{4} =$

12. $1000 \times 6.75 =$

13. $2\frac{1}{2} \div \frac{3}{4} =$

14. 104% of 380 =

15. $\frac{1}{4}$% of 1780 =

16. 27 = ?% of 50

17. 40 = 8% of ?

Hospital Insurance

Mr. Adler was a patient in a hospital for two weeks. Because he carried **hospitalization insurance**, an insurance company paid most of his hospital bills. According to this plan of insurance, the company agreed to pay a certain amount per day for a certain number of days Mr. Adler was a patient in a hospital. In return, Mr. Adler paid a yearly premium for the protection given.

Persons over 65 or 70 years of age usually cannot be insured at the regular rate. In a family plan of insurance, all children must be under 18 years of age.

The table gives the rates of hospitalization insurance for one company.

Number of Persons	Monthly Rate	Yearly Rate
1 person	$1.50	$17.00
Man and wife	2.25	26.00
Man, wife, and 1 child	2.50	28.50
Man, wife, and 2 children	2.75	31.00

1. Find the cost of hospitalization for a year for a man and wife when the premium is paid at the monthly rate; at the yearly rate.

2. Find the yearly premium for one person when it is paid by the month; when it is paid by the year. To the nearest per cent, what per cent of the yearly premium when paid by the month may be saved by making a yearly payment?

3. How much extra is the yearly cost for each child in a family plan of insurance when it is paid by the month?

4. A man, wife, and 2 children are insured for hospital benefits at the rate shown in the table. Find the yearly premium when it is paid by the month; by the year.

5. For each extra person in a family, such as an aunt or uncle, the rate for insurance in some companies is the same as for one person. Find the cost to insure a family for one year when the family consists of man, wife, 2 children, and an aunt if the premium is paid by the month; if the premium is paid by the year.

6. The amount of the benefits a policy pays is not the same for all companies. One company pays a patient $7.50 a day up to 21 days of hospitalization and $3 a day for the next 30 days. What is the greatest amount that may be collected under this plan?

7. Another plan of hospitalization will pay $200 for the first 21 days and $3.50 a day for the next 180 days in a hospital. What is the greatest amount a patient may collect under this plan?

8. The average number of days of hospitalization for a patient is 12 days. At a rate of $7.50 a day, what is the amount of the benefit paid to the average patient?

9. In problem 8, how many yearly premiums, at an average yearly premium of $15 a person, are needed to pay the cost of the benefits paid to the average patient who receives hospitalization benefits?

10. It has been found that every day an average of 3,437 persons become hospitalized for the first time. To the nearest thousand, how many patients are admitted to a hospital for the first time during the month of April?

11. The income from each dollar that a large hospital receives is distributed as follows: Nursing, 27¢; special services, 22¢; food, 18¢; maintenance, 21¢; administration, 12¢. Show these facts by a circle graph.

★12. Do you have a hospitalization plan in your province? What is it called? Find out about costs of hospitalization in your province.

Life Insurance

Life insurance protects a family against loss of income due to the death of the wage earner. If a family depends upon the earnings of one person as its only source of income, the family would be without an income when he dies unless he has life insurance.

The person named in a policy to receive the amount (the money) or **face of the policy** upon the death of the insured is called the **beneficiary.** All life insurance policies **mature** at the death of the insured, but some policies mature while the insured is living. A life insurance policy is said to mature when its cash value is equal to its face value.

There are three well-known kinds of life insurance policies:

a. **Straight or whole life** policy in which the insured pays the yearly premium throughout his lifetime.

b. **Limited payment life** policy in which the insured pays the yearly premium for a given number of years, as 20 years, but the policy matures only at the death of the insured.

c. **Endowment policy** in which the insured pays the yearly premium for a given number of years, as 20 years, and then the policy matures even though the insured may still be living.

1. How does a straight life policy differ from a limited payment life policy?

2. How does an endowment policy differ from a limited payment life policy?

3. In which of the three policies is it possible for the insured to collect the face of the policy?

★4. For a person aged 25, on which of the policies for $1000 do you think the yearly premium would be highest? On which would it be lowest? Why? (See page 219).

★5. If a person takes out a life insurance policy for $10,000 and the next day is in a fatal accident, the company will pay the beneficiary $10,000. How can the company afford to pay the face of the policy since the insured paid only one premium?

★6. What is meant by "group insurance"? How does the rate for group insurance compare with the rates given on page 219?

Cost of Life Insurance

The table gives the yearly premium on each $1000 of insurance for each of three policies at different ages of the insured.

Age of Insured	Kind of Policy		
	Straight Life	20-Payment Life	20-Yr. Endowment
20	$15.39	$26.16	$44.62
25	17.63	28.77	45.12
30	20.52	31.77	45.88
35	24.14	35.26	47.11
40	28.76	39.45	49.00

1. Tell on which kind of policy the rate is highest at age 20; at age 30; at age 40.

2. Find how much lower the yearly premium is per $1000 of insurance at age 20 than at age 35 for a straight life policy; for a 20-payment life policy; for a 20-year endowment policy.

3. If a person aged 25 takes a 20-year endowment policy for $1000 and he lives until the policy matures, what would be the total of the premiums paid at the rate given above? The amount he would collect when the policy matures is how much more than the total premiums paid?

4. If a person takes out a 20-payment life policy at the age of 30, how old will he be when the policy is paid up?

5. Read across the top of the table and then down the column on the left. What two things affect the size of the yearly premium on an insurance policy of $1000?

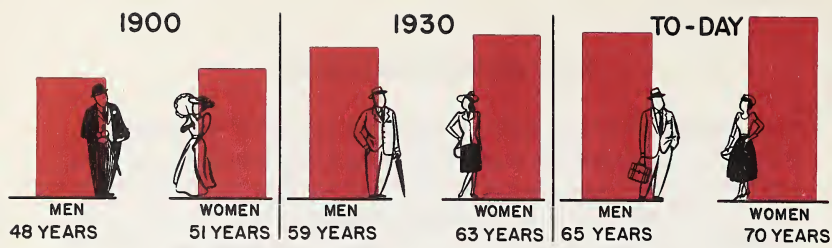
6. Find the yearly premium on each of the following:

   a. A straight life policy of $6500, age of insured, 30.

   b. A 20-payment life policy of $5200, age of insured, 25.

   c. A 20-year endowment policy of $7500, age of insured, 35.

   d. A straight life policy of $12,500, age of insured, 40.



Our Life Span

The life span of humans is the average age at which people die.

1. If a child dies at the age of 1 year and one parent lives to be 90, what is the average age of these two people?

2. According to the graph, do men or women have the longer life span?

3. What was the average life span of men in 1900? in 1930? What is the average span of life of men today?

4. What was the average life span of women in 1900? in 1930? What is the average span of life of women today?

5. To the nearest per cent, what was the per cent of increase in life span from 1900 to today for men? for women?

6. The average life span of people in this country during the past 100 years has been as follows:

1850....40 yr.; 1900....50 yr.; 1950....67 yr.

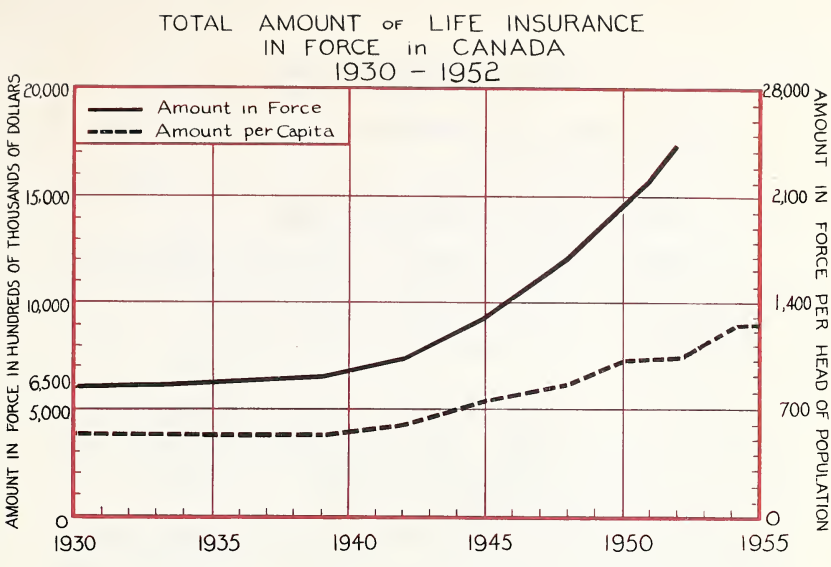
a. What was the per cent of increase in life span from 1850 to 1900? from 1850 to 1950?

b. What was the per cent of increase in life span from 1900 to 1950?

7. The average life span of people living 2000 years ago was 23 years. The average life span in this country today is approximately how many times as much as the life span of people living 2000 years ago? This is an increase of approximately what per cent?

★8. As the life span increases, the yearly premium on an insurance policy should decrease. Why?

★9. What are some of the reasons why the average life span has increased in this country during the past 50 years?



Canadians Invest in Life Insurance

1. Approximately how much life insurance was held by Canadians in 1930? in 1935? in 1940? in 1945? in 1951?

2. In what year was the total life insurance in force double the amount in force in 1930?

3. The amount of life insurance **per capita** means the amount in force per head of population. The amount of life insurance in Canada per capita in 1940 was approximately $613. In what year is this amount about doubled?

4. The amount of life insurance in force in Canada in the census year 1951 was $1,723,500,000 which was a gain of $149,000,000 over the previous year. What was the gain per cent over the previous year?

5. Using the figures given in problem 4 for the total life insurance in force and the gain over the previous year, what was the amount in force per capita? the gain per capita? (1951 census, 14,000,000).

★ **6.** Does the amount per capita increase at the same rate as the total amount in force? Why?

Reviewing Insurance

1. What is meant by the yearly premium? What is the face value of an insurance policy?

2. A house is insured for $7500 against loss by fire. Find the yearly premium at 23¢ per $100 of insurance.

3. A house is insured for $8400 for a 3-year period at $2\frac{1}{2}$ times the rate for one year. If the yearly rate is 18¢ per $100, what is the average yearly cost of the insurance on the house?

4. Name at least two things which affect the rate for fire insurance.

5. The yearly premium for a policy of $10,000–$20,000 liability insurance on a car was $33. The cost of doubling the policy was $3 more. Approximately what was the per cent of increase in the premium for a policy of $20,000–$40,000?

6. Before it is possible to be insured by one of the three types of policies given on page 218, the person seeking the insurance must pass a medical examination. Why?

7. At a recent date, the face value of the average ordinary policy of life insurance in this country was $2438. If a company had 2500 policies of this amount, what was their total face value?

8. In 1930 the face value of all ordinary life insurance policies in this country was 6.5 billion dollars. In 1950 the face value of these policies was 15.7 billion dollars. What was the per cent of increase in the value of these policies?

★9. The picture shows how a crop may be ruined by a windstorm. A farmer may have his crop insured against loss by taking crop insurance. What are some of the things which would affect the cost of crop insurance?

Getting Ready for the Progress Test in the Fundamentals

I. Add:

1. $\begin{array}{r} 508 \\ 361 \\ 2786 \\ 59 \\ 427 \\ \underline{3195} \end{array}$

2. $\begin{array}{r} .47 \\ .55 \\ .08 \\ .36 \\ \underline{.75} \end{array}$

3. $\begin{array}{r} 6\frac{1}{3} \\ 2\frac{1}{2} \\ 1\frac{5}{6} \\ \underline{7\frac{3}{4}} \end{array}$

4. $\begin{array}{r} 2\frac{9}{16} \\ 1\frac{5}{8} \\ 6\frac{3}{4} \\ \underline{7\frac{1}{2}} \end{array}$

5. $\begin{array}{r} 5 \text{ min. } 19 \text{ sec.} \\ \underline{7 \text{ min. } 46 \text{ sec.}} \end{array}$

6. $\begin{array}{r} 3 \text{ yd. } 27 \text{ in.} \\ \underline{1 \text{ yd. } 18 \text{ in.}} \end{array}$

II. Subtract:

1. $\begin{array}{r} 7125 \\ \underline{4238} \end{array}$

2. $\begin{array}{r} 9002 \\ \underline{346} \end{array}$

3. $\begin{array}{r} 32{,}107 \\ \underline{18{,}536} \end{array}$

4. $\begin{array}{r} 6 \\ \underline{1\frac{5}{8}} \end{array}$

5. $\begin{array}{r} 7\frac{1}{3} \\ \underline{2\frac{3}{4}} \end{array}$

6. $\begin{array}{r} 15\frac{3}{4} \\ \underline{9\frac{7}{8}} \end{array}$

7. $\begin{array}{r} .935 \\ \underline{.756} \end{array}$

8. $\begin{array}{r} .025 \\ \underline{.018} \end{array}$

9. $\begin{array}{r} 23 \text{ min. } 15 \text{ sec.} \\ \underline{14 \text{ min. } 36 \text{ sec.}} \end{array}$

III. Multiply:

1. $\begin{array}{r} 675 \\ \underline{4} \end{array}$

2. $\begin{array}{r} 906 \\ \underline{9} \end{array}$

3. $\begin{array}{r} 478 \\ \underline{37} \end{array}$

4. $\begin{array}{r} 760 \\ \underline{80} \end{array}$

5. $\begin{array}{r} 73.5 \\ \underline{6.4} \end{array}$

6. $\begin{array}{r} .54 \\ \underline{.05} \end{array}$

7. $\begin{array}{r} 38 \\ \underline{5\frac{3}{4}} \end{array}$

8. $\begin{array}{r} 87\frac{1}{2} \\ \underline{9} \end{array}$

9. $\begin{array}{r} 7 \text{ ft. } 8 \text{ in.} \\ \underline{4} \end{array}$

10. $2\frac{1}{2} \times 7 =$

11. $3\frac{1}{2} \times 1\frac{1}{4} =$

12. $3\frac{1}{7} \times 3\frac{1}{2} \times 4\frac{3}{4} =$

13. 103% of 450 =

14. 6.5% of 970 =

15. $\frac{1}{4}$% of 3260 =

IV. Divide:

1. $6\overline{)4037}$

2. $18\overline{)9371}$

3. $450\overline{)25387}$

4. $.05\overline{)16}$

5. $4\overline{).13}$

6. $1.6\overline{).912}$

7. $36 \div 1\frac{1}{2} =$

8. $9\frac{3}{4} \div 3\frac{1}{4} =$

9. $\frac{7}{8} \div 1\frac{1}{8} =$

10. $2\frac{1}{2} \div 4 =$

11. $2 \div .001 =$

12. $4\overline{)3 \text{ ft. } 2 \text{ in.}}$

13. $15 = ?\%$ of 75

14. 20% of $? = 1$

15. $7 = ?\%$ of 25

The Vocabulary of Arithmetic

Define, illustrate, or use in a sentence each of the terms given below. The number in parentheses shows where the term is introduced.

Beneficiary	(218)	Liability insurance	(214)
Bond	(193)	Limited payment life policy	(218)
Brokerage	(207)	Market value	(206)
Canada Savings Bond	(200)	Par value	(204)
Compound interest	(194)	Per Capita	(221)
Corporation	(205)	Property damage insurance	(214)
Endowment policy	(218)	Savings bank	(191)
Face of policy	(211)	Stock certificate	(204)
Hospitalization insurance	(216)	Stock dividend	(204)
Insurance policy	(211)	Stock exchange	(206)
Insurance premium	(210)	Straight life policy	(218)

Expressing Measurements in Different Units

Find the missing numbers in each of the following:

1. 4 ft. 8 in. = ? in.
2. 3 min. 20 sec. = ? min.
3. 1 yd. 9 in. = ? yd.
4. 4 m. 20 cm. = ? cm.
5. 6 km. 750 m. = ? km.
6. 2500 grams = ? kg.
7. 2 bu. 3 pk. = ? pk.
8. 2°45′ = ?°
9. 1 min. 24 sec. = ? min.
10. 3 pt. 8 fl.oz. = ? fl.oz.
11. 3 gal. 1 qt. = ? qt.
12. 2 lb. 10 oz. = ? lb.
13. 6 cm. 4 mm. = ? mm.
14. 4 hr. 18 min. = ? hr.
15. 6 lb. 5 oz. = 5 lb. ? oz.
16. 3 min. 29 sec. = 2 min. ? sec.
17. 140 in. = ? ft.
18. 2400 lb. = ? ton
19. 360 cm. = ? m.
20. 4.25 km. = ? m.
21. 76 cm. = ? m.
22. 40 fl.oz. = ? pt.
23. 150 pt. = ? gal.
24. 48 rd. = ? ft.
25. .6 mi. = ? ft.
26. 1.4 hr. = ? min.
27. .3 ft. = ? in.
28. 12,500 lb. = ? ton

Chapter Test

1. Find the semi-annual interest on the following deposits:

a. \$600 at 2%
b. \$450 at 1%
c. \$960 at $1\frac{1}{2}$%
d. \$1200 at 3%
e. \$1500 et $2\frac{1}{2}$%
f. \$2500 at $1\frac{1}{2}$%

2. Find the amount of \$1000 at 3% compounded annually for 2 years.

3. Canada Savings bonds, Series 8, for \$3500 were purchased at date of issue. What is the value of the coupons on May 15? on July 15?

4. What would be the advantage of selling \$2500 of Series 3 bonds and purchasing the same amount of Series 8 bonds?

5. What is the market value of 100 shares of stock selling at $107\frac{3}{4}$?

6. At a rate of 18¢ a \$100 for fire insurance, find the yearly cost to insure a house for \$7500 against loss by fire.

7. If the cost of a policy for 3 years is only $2\frac{1}{2}$ times the yearly cost, how much is the yearly premium paid on a house insured for \$4500 against loss by fire for 3 years at 24¢ a \$100?

8. A policy for liability insurance on a car is \$10,000—\$20,000. What is meant by each of the items in this statement?

9. The yearly premium for the policy in problem 9 is \$42.60. For 15% more than this amount, the face of the policy may be doubled. Find the cost of the premium on a policy of \$20,000—\$40,000.

10. Give the names of three kinds of policies in life insurance. How do these three types of policies differ?

11. What is meant by hospitalization insurance?

12. What is meant by "life span"?

13. When the average life span increased from 40 years to 67 years, what was the per cent of increase?

14. As the life span increases, how does that affect the yearly premium on a life insurance policy?

Progress Test in the Fundamentals

Solve the following examples:

1.	2.	3.	4.	5.
.475	63,431	936	$15\frac{1}{2}$	.950
(48) .388	(8) $-37{,}585$	(11) $\times 407$	(25) $-7\frac{5}{8}$	(48) $-.786$
.964				
.750	6. $17\overline{)8852}$	7. $1.5\overline{)42}$		8. $.36\overline{).144}$
.692	(16)	(69)		(71)

9. $7\frac{1}{3}\times\frac{5}{6}=$ (29)	10. $3\frac{1}{3}\times2\frac{1}{2}\times4\frac{3}{4}=$ (29)	11. $\frac{9}{10}\div2\frac{1}{4}=$ (34)
12. $36\div\frac{4}{9}=$ (34)	13. 4.6% of 350 = (92)	14. 125% of 720 = (92)
15. 32 = ?% of 108 (98)	16. 28 = ?% of 25 (98)	17. 50 = 10% of ? (108)
18. 6% of ? = 24 (108)	19. $2\frac{1}{2}$% of 1240 = (92)	20. 75 = 150% of ? (108)

If you did not understand how to solve an example, turn for help to the page given in parentheses where the step is explained.

★For Those Who Made No Error on the Above Test

1. Have one member of your class consult the Canada Year book to secure information about the following:

   a. What were the fire losses in your province in 1950?

   b. How many fires were reported due to smokers carelessness in 1951?

   c. What was the loss due to smokers carelessness in 1951?

2. Communities are classified at different levels of risk in determining rates for fire insurance. Class A is the highest classification, but has the lowest risk and the lowest rate. Find the rating for your town or city. What are some of the things which determine the classification for fire insurance in a given community?

3. What is an **annuity**? How does an annuity differ from life insurance? An annuity of $1000 for a woman of a given age costs more than one for a man of the same age. Why?

Test in Problem Solving

Solve the following problems. If you are unable to solve a problem, turn for help to the page indicated on the right.

1. The long hand of the altimeter shown on the right points to hundreds and the short hand points to thousands. What is the height in feet registered on the dial of the altimeter? (50)

2. In one game a basketball team was successful in 28 out of 73 attempted shots at the basket. To the nearest per cent, what per cent of the shots were successful? (98)

3. A suit cost $60 when sold at 80% of the regular price. What was the regular price? (108)

4. One part of a circle graph represents 55% of the circle. How many degrees are there in the central angle to represent this part? (155)

5. One base of a trapezoid is 36 feet and the other base is 54 feet. If the distance between the bases is 20 feet, what is the area of the trapezoid? (147)

6. An isosceles triangle has two equal angles, each of which is 58°. How many degrees are there in the third angle of the triangle? (143)

7. How many days are there from March 15 to the following July 10? (170)

8. The semi-annual interest on a loan of $500 is $12.50. What is the rate of interest? (169)

9. When interest is compounded annually, how much more is the compound interest than the simple interest on $1000 at 4% for 2 years? (194)

10. A house is insured for $6800 against loss by fire at a rate of 18¢ a $100. Find the yearly premium on the insurance policy. (212)

1
2
3

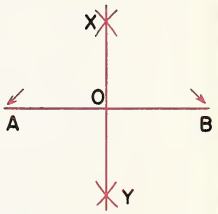
Bisecting a Line and an Angle by Measurement and by Construction

The boy shown on page 228 is **bisecting** a line by **measurement**. To bisect a line by measurement, find the midpoint of the line. Use a ruler to measure the length of the line. Divide this result by 2. Begin at one end of the line and mark off this distance on the line.

The girl shown on page 228 is bisecting an angle by measurement. To bisect an angle by measurement, use a protractor to find the number of degrees in the angle and divide the result by 2. Now mark on your paper a point which locates the middle of the angle. Connect this point with the vertex of the angle.

1. Use measurement to bisect a line of $2\frac{1}{4}$ inches; to bisect an angle of 78°.

2. The figure on the right shows how to bisect a line by **construction**. In construction you use a ruler and compasses. The arcs which **intersect** (cut each other) at X and Y form two points. The line connecting these points forms a **perpendicular bisector** of AB. Use your protractor to prove that each angle at O is a right angle.

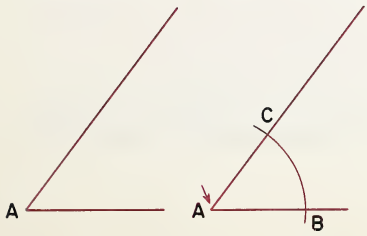


3. Draw lines of the following lengths and construct the perpendicular bisector of each:

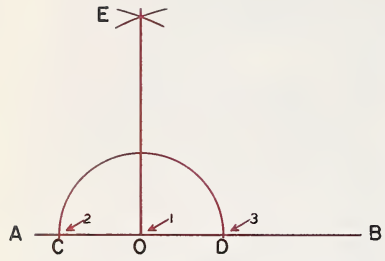
a. $2\frac{1}{2}$ in. b. $3\frac{1}{2}$ in. c. $1\frac{3}{4}$ in.

4. The figures below show the steps in bisecting an angle. Which points were used as centers to form the intersecting arcs at O?

5. Draw angles of 56°, 110°, and 158°. Bisect each angle by construction. Check your construction with a protractor.



Constructing Perpendiculars



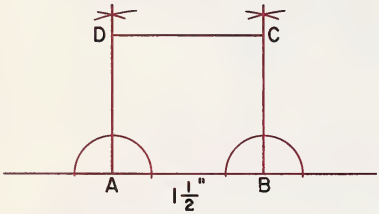
1. Draw a line AB, 3 inches long. From a point O 1 inch from A, construct a perpendicular to AB.

Using O as a center and a radius equal to or less than 1 inch, draw an arc intersecting the line AB at C and D.

Trace the remaining steps in the construction shown.

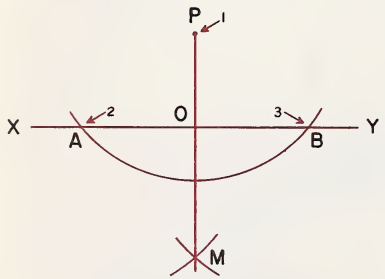
2. Draw a line and select any point P on this line. At this point construct a perpendicular to the line. Check the accuracy of your construction with a protractor.

3. Construct a square having the same dimension as that shown in the figure on the left.



Draw a line. Mark off on this line any two points A and B, $1\frac{1}{2}$ inches apart. At points A and B, construct perpendiculars to the line. Mark off lines BC and AD, each $1\frac{1}{2}$ inches long. Complete the construction to form a square.

4. The figure below shows how to construct a perpendicular to the line from a point P which is not on the line.



a. Using P as a center, an arc is drawn intersecting the line at points A and B. Why must the opening of the compasses be greater than the distance PO?

b. Which points are used as centers to draw the intersecting arcs at M? What radius is used?

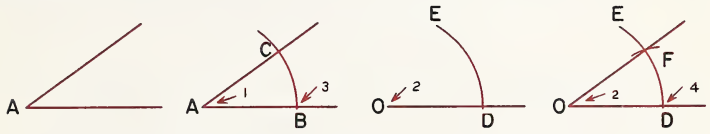
5. Draw a triangle ABC with the base AB. From C construct an altitude to the base AB. (The altitude is perpendicular to the base.)

How to Construct a Line Parallel to a Given Line

1. Name three different kinds of figures studied this year in which there are at least two sides parallel.

To construct a line parallel to another line, you must be able to construct an angle equal to a given angle.

2. If angle A is any given angle, construct angle O equal to angle A.



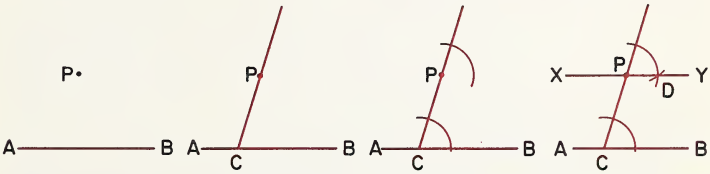
a. Trace the steps in the construction.

b. The length of the line OD is the same length as which line in angle BAC?

c. Using D as a center, what radius must be used to form the arc intersecting at F?

3. Draw an angle of 40° and construct an angle equal to it. Draw angles of 75° and 130°. Using the method shown above, construct angles equal to each, respectively.

4. At the point P construct a line parallel to a given line AB.



PC is any line drawn through P which cuts AB.

a. Trace the steps in the construction.

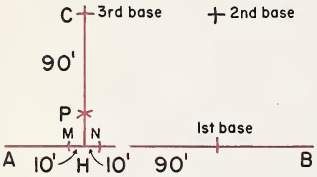
b. The angle constructed at P is equal to which angle?

c. Connect points P and D to form the line XY parallel to AB.

5. Draw a line MN and select a point O not on this line. Through O construct a line parallel to MN. Check with your ruler to find if the distance between the two lines is the same at all points.

Application of Constructions

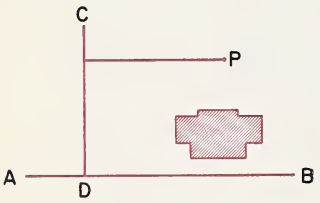
1. A group of boys laid out a baseball diamond. They selected the point H for home plate. Then they measured a distance of 90 feet along HB to locate first base. Using the point H as a center on the line AB, they measured off HM and HN each 10 feet in length. If the boys had only a string or tape, show how it was possible to locate the line CH perpendicular to AB.



a. What points did the boys use as centers to draw the arcs intersecting at P?

b. How can the point for second base be located?

2. It is necessary to know the distance (perpendicular) from the point P to line AB which represents a street, but there is a building between the point and the street as illustrated. Show how it is possible to find the distance from P to the street.



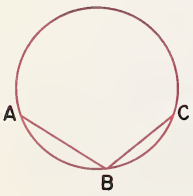
a. On AB select a point D which is either to the left or right of the building. Construct a perpendicular from D. This perpendicular must be extended so that its length is greater than which distance?

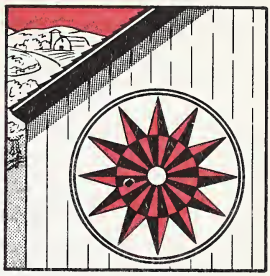
b. From P construct a perpendicular to CD.

c. Which line has the same length as the distance from the point P to the line AB?

d. Make a copy of the construction.

3. A machinist had to bore a hole at the center of a metal disk. He drew two lines (**chords**) on the disk as shown. Then he constructed perpendicular bisectors of these two lines. The point at which the bisectors met was the center of the circle. Draw a circle by tracing a line around the edge of a disk, such as a half dollar. Find the center of this circle by construction.





Geometry in Designs

The illustrations show geometric figures used in decorations.

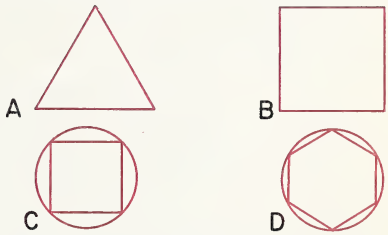
1. What geometric figures are shown on the doily?

2. A figure of six sides is called a **hexagon**. Find two illustrations of hexagons in the picture.

3. How many points are shown on the circumference of the large circle which appears on the barn?

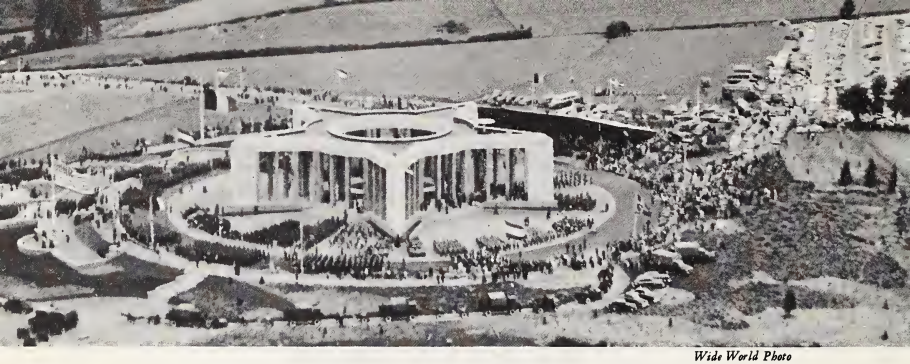
4. A plane figure whose sides are bounded by straight lines is a **polygon**. If the sides and the angles of a polygon are equal, the figure is a **regular polygon**. Give the name of the regular polygon shown in A; in B.

5. A polygon is **inscribed** in a circle if each vertex of the polygon is on the circle. What name is given to the figure in C? in D?



6. Draw a circle having a diameter of 2 inches and inscribe a square. To find the points on the circle for the vertices (plural of vertex) of the inscribed square, construct two diameters perpendicular to each other.

7. Draw a circle with a radius of $1\frac{1}{2}$ inches and inscribe a regular hexagon. The side of a regular hexagon is equal to the radius of the circle. Keep the opening between the points of the compasses equal to $1\frac{1}{2}$ inches. Begin at any point on the circle and mark off in succession 6 equal arcs on the circle. Then connect the 6 points in succession with straight lines.



Wide World Photo

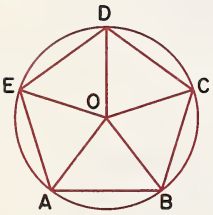
The Pentagon at Bastogne

The picture shows the Bastogne War Memorial, Bastogne, Belgium.

1. A polygon of five sides is a **pentagon.** Is the top of the memorial a pentagon? Give reasons for your answer.

2. The distance from an outermost point to the next outermost point at the base of the memorial is 203 feet. What is the perimeter of a regular pentagon having a side of this length?

3. The diameter of the circle in the center of the star is 65.5 feet. What is the circumference of this circle? (Use $\pi = 3.14$.)



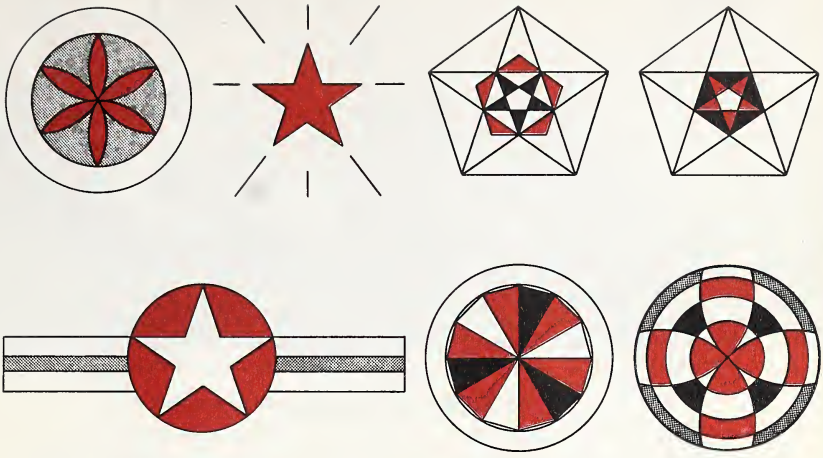
4. The figure ABCDE is an inscribed regular pentagon. In the inscribed polygon, how many degrees are there in each central angle at O?

5. To inscribe a regular pentagon in a 3-inch circle, draw a circle with a radius of $1\frac{1}{2}$ inches and then draw five central angles of 72° each. Draw radii for the sides of the angles. Connect the five points on the circle with straight lines.

6. The designs below are based on a pentagon. Make a copy of at least one of these designs.

★7. What is the Pentagon Building? Where is it located?

★8. What does the Bastogne Memorial commemorate?



Making Copies of Designs

1. Make a copy of at least two of the designs shown above.

★2. Make an original design based on one or more of the figures you have studied.

★3. Bring to class copies of designs found in newspapers or magazines.

Practise What You Have Learned

1. $\begin{array}{r} \$\ 7.85 \\ 28.67 \\ 0.98 \\ 6.24 \\ 31.16 \\ \underline{5.76} \end{array}$

2. $\begin{array}{r} 4\frac{1}{2} \\ 2\frac{3}{4} \\ 1\frac{5}{6} \\ \underline{4\frac{1}{3}} \end{array}$

3. $\begin{array}{r} 94{,}056 \\ \underline{-38{,}097} \end{array}$

4. $\begin{array}{r} 508 \\ \underline{\times 307} \end{array}$

5. $\begin{array}{r} 68 \\ \underline{\times 4\frac{3}{4}} \end{array}$

6. $\begin{array}{r} 7\frac{1}{2} \\ \underline{-4\frac{5}{6}} \end{array}$

7. $\begin{array}{r} 680 \\ \underline{\times 430} \end{array}$

8. $375\overline{)92465}$

9. $1.6\overline{)40}$

10. $2.5\overline{)1.4}$

11. $5\overline{)32}$

12. $.04\overline{)7}$

13. $\frac{3}{4} \div \frac{5}{6} =$

14. $1\frac{1}{2} \times \frac{7}{8} =$

15. $1 \div \frac{5}{8} =$

16. $\frac{3}{5} \div 4 =$

17. $2\frac{1}{2} \times 3\frac{1}{4} \times \frac{5}{6} =$

18. $\frac{4}{5} = ?\%$

19. 102% of $380 =$

20. $\frac{1}{4}\%$ of $780 =$

21. $5 = ?\%$ of 30

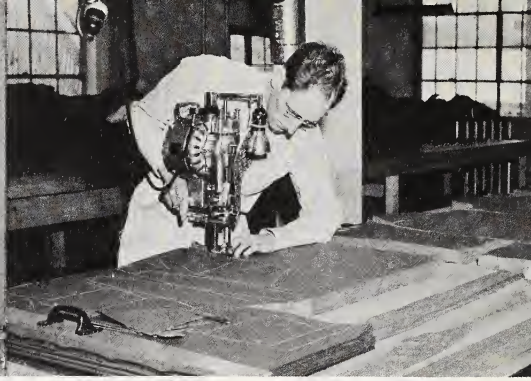
22. $31 = ?\%$ of 20

23. $6 = 4\%$ of ?

24. 150% of ? $= 75$

25. $90 = 6\%$ of ?

Ewing Galloway



Boyer from C. P. Cushing

Mass Production

Diane is using a pattern to cut cloth to make a dress. The picture on the right shows a machine which cuts out a part of a dress. Each part cut out has the same size and the same shape. Figures which have the same size and same shape are said to be **congruent.** Two congruent figures may be placed one on the other so as to **coincide** (that is fit over each other perfectly).

1. If two polygons are congruent, are their areas necessarily equal? Why?

2. In **mass production,** one machine turns out many copies of the same article in a manufacturing plant. Name at least four articles that are made by mass production methods in a plant which manufactures automobiles; which manufactures airplanes.

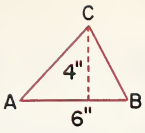
3. Is page 236 of this textbook congruent to the same page of the text used by each other member of your class? Under what conditions would these pages not be congruent?

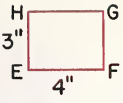
4. Doris and Walter each took a copy of a newspaper to school. Were the front pages of the newspapers necessarily congruent?

5. Draw two equilateral triangles which are congruent; which are not congruent.

6. Are two squares with the same area necessarily congruent?

7. If two rectangles have the same area, are they necessarily congruent? Prove your answer by a drawing or by substituting different pairs of numbers in the formula for the area.





Same Size—Different Shape

1. What is the area of triangle ABC? What is the area of rectangle EFGH?

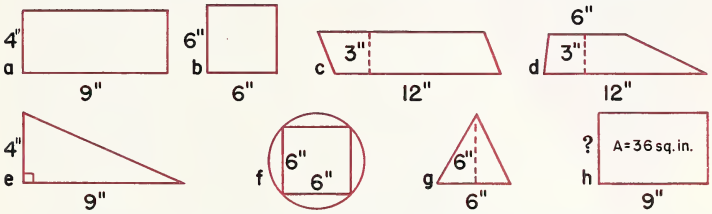
The areas of the two figures are equal, but the shapes of these figures are different. Figures which have equal areas are **equivalent**. They may have different shapes.

2. How do congruent figures differ from equivalent figures?

3. If two squares are equivalent, are they necessarily congruent?

4. If two equilateral triangles are equivalent, are they necessarily congruent?

5. Draw two triangles that are equivalent, but not congruent.



6. In the figures above, which figures are equivalent to a?

7. Which figure is congruent to a?

8. In problem 7 you found a pair of figures that are congruent. Name another pair of figures from the above group that are congruent.

9. Are figures e and g equivalent or congruent?

★10. Draw two triangles that have equal bases and equal altitudes and are equivalent, but not congruent.

★11. Two isosceles triangles have equal areas. Make drawings to show that they do not have to be congruent.

★12. Each of two isosceles triangles has a base of 10 inches. If the triangles are equivalent, substitute numbers in the formula for the area of a triangle to show that the altitudes must be equal.

Symmetry

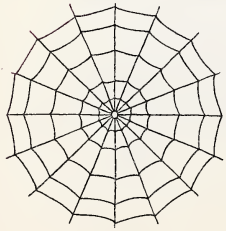
A figure which can be cut by a line into two parts of the same size and shape is **symmetrical**. The line which divides the figure into two equal parts is the **axis of symmetry**. The picture shows the design on a necktie. Hold the right side of this book toward you. What name are you able to read? The line which cuts the design into two equal parts is the axis of symmetry.

We sometimes say that a symmetrical figure is well **balanced**. Illustrations of symmetry may be found in architecture and in forms of plant and animal life.

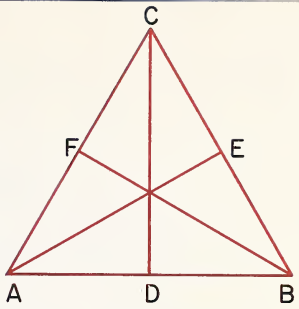
1. The pictures of leaves shown above are symmetrical. What is the axis of symmetry of each?

2. The other picture above shows the flag of the United Nations. Point out illustrations of symmetry on the flag.

3. Point out illustrations of symmetry in the pictures below.



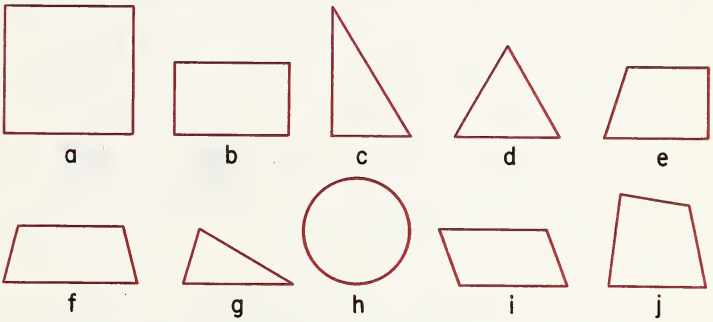
How Many Axes of Symmetry?



It is possible to have more than one axis of symmetry in some figures.

1. Triangle ABC is equilateral. CD is one axis of symmetry. Name two more axes (plural of axis) of symmetry in the triangle.

In some of the figures below it is not possible to draw an axis of symmetry. In some of the other figures, it is possible to draw only one axis of symmetry and in others, more than one axis of symmetry.



2. Which of the figures given above have only one axis of symmetry? Which have more than one axis of symmetry? Which have no axis of symmetry?

3. Draw an isosceles triangle. How many axes of symmetry is it possible to draw in the triangle?

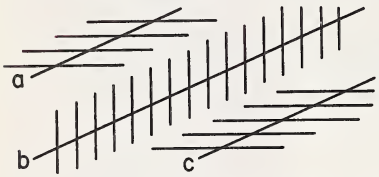
4. What name is given to an axis of symmetry of a circle?

5. Place a drop of ink on a sheet of paper. Then fold the paper along the edge of the dot and press along the fold. After allowing time for the paper to absorb the ink, open the fold. The ink should form a symmetrical figure. What is the axis of symmetry? How many axes of symmetry does the figure have?

★6. If you are making a study of trees in your work in science, make a list of some of the kinds of leaves that are symmetrical.

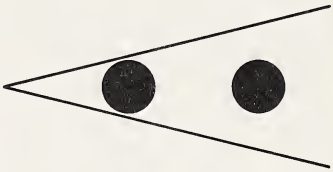
Is Seeing Believing?

1. Which of the lines above seems to be the longer? Measure the lines to see if you were right.



2. Lines a, b, and c are parallel even if they do not appear to be parallel. Measure the distance at several points between any two of these lines to prove that these lines are parallel.

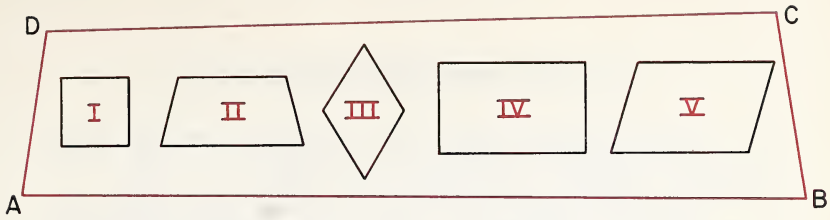
3. Which of the circles on the right seems to be the larger? Measure the diameter of each circle to prove that the circles have equal diameters. If the circles have equal diameters, what can you say about their areas?



4. If any two circles have equal radii, how do the areas of the circles compare? How do the circumferences of the circles compare?

5. Look at the white figure against a black background. The figure is a goblet. Now look at the black figure against a white background. What does the outline of the black figure look like?

6. Draw a horizontal line AB, 3 inches long. Construct a perpendicular bisector of this line. Without the use of a ruler, extend the bisector approximately 3 inches above the line AB. Measure the part which extends above AB. Was your approximation correct?



Quadrilaterals

A **quadrilateral** is a polygon of four sides. The small polygons shown within the large quadrilateral above are special kinds of quadrilaterals.

1. Are any two of the sides of the quadrilateral ABCD equal? Measure them. Are any two of the angles equal? Measure them.

2. Which of the quadrilaterals is a square? a rectangle? a trapezoid? a parallelogram which does not have right angles?

3. Measure the sides of quadrilateral III. Are they equal?

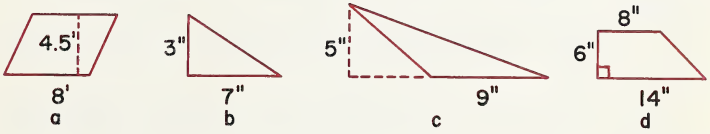
4. How does quadrilateral III differ from a square?

5. A quadrilateral which has equal sides but pairs of unequal angles is a **rhombus**. Which figure above is a rhombus?

★6. Make a poster showing the different kinds of quadrilaterals.

Finding Areas of Figures

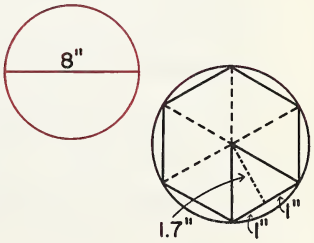
1. Find the area represented by each of the following figures:



2. What is the circumference of the circle on the right? What is the area of the circle? ($\pi = 3.14$)

3. What is the length of a side of the regular inscribed hexagon? What is the perimeter of the hexagon?

4. Find the area of the hexagon.



Our Number System

1. Using each of the digits 1, 2, 5, and 8 once, write the largest four-place number in which 8 is in tens' place.

2. Using the digits in problem 1 once each, write the smallest four-place decimal fraction in which 5 is in hundredths' place.

3. Without repeating a digit, write the largest four-place number in which 9 is in tens' place.

4. Each of the following four-place numbers is to be made divisible by 9. Find the missing digit in 43?6; in 2?58; in 638?; in ?288.

5. How many tenths are there in 2? in 2.5? in 1.25? in .75?

6. How many hundreds are there in 7300? in 250? in 1250? in 7225? in 100,000?

7. Give the number of hundreds, and tens, in 738 when it is regrouped so that the number in the example on the right may be subtracted.

$$\begin{array}{r} 738 \\ -256 \\ \hline \end{array}$$

8. In the example on the right, by what number would the quotient be multiplied or divided:

$$.5\overline{).45}$$

   a. If the .5 is changed to 5, but the .45 is unchanged?

   b. If the .45 is changed to 45, but the .5 is unchanged?

   c. If the .5 is changed to 5 and the .45 is changed to 45?

9. The value of the 2 in 275 is how many times the value of the 2 in .25?

10. The value of the 3 in 1.3 is what fractional part of the value of the 3 in 35?

11. The value of the 4 in 470 is how many times the value of the 8 in 238?

12. In the example on the right, how is the product affected if the 7.2 is changed to 72 and the 3.4 is changed to .34?

$$\begin{array}{r} 7.2 \\ \times 3.4 \\ \hline \end{array}$$

13. The digit 2 is five places to the left of ones' place. What is the value of the 2?

14. The digit 2 is four places to the right of ones' place. Write the value of the 2.

Practise What You Have Learned

1. $7\frac{2}{3}$
   $5\frac{1}{4}$
   $8\frac{5}{6}$
   $4\frac{1}{2}$

2. 10,325
   -748

3. 684
   $\times 307$

4. 58
   $\times 6\frac{3}{4}$

5. $9\frac{1}{2}$
   $-4\frac{2}{3}$

6. 67.5
   $\times 3.4$

7. $27\overline{)82345}$

8. $.12\overline{)9}$

9. $1000 \times 3.14 =$

10. $4.6 \div 100 =$

11. $18 \div \frac{4}{5} =$

12. $2\frac{1}{2} \times 3\frac{1}{4} =$

13. $\frac{3}{4} \times 4\frac{1}{2} \times 7\frac{1}{3} =$

14. $2\frac{1}{4} \div \frac{7}{8} =$

15. 1.5% of 760 =

16. 103% of 940 =

17. 16 = ?% of 25

18. 120 = ?% of 90

19. 12 = 3% of ?

20. 250% of ? = 100

21. 4 lb. 8 oz.
    3 lb. 9 oz.
    15 oz.

22. 15 min. 24 sec.
    -9 min. 35 sec.

23. 8 ft. 9 in.
    $\times 4$

Number Quickies

1. What is the perimeter of a 6-in. square?

2. The perimeter of a square is 12 inches. What is the area of the square?

3. What is the perimeter of an isosceles triangle which has a base of 6 inches and two equal sides each of which is 7.5 inches?

4. The diagonal of a square is 1.4 times as long as a side of the square. Find the diagonal of a square having a side of 8 inches.

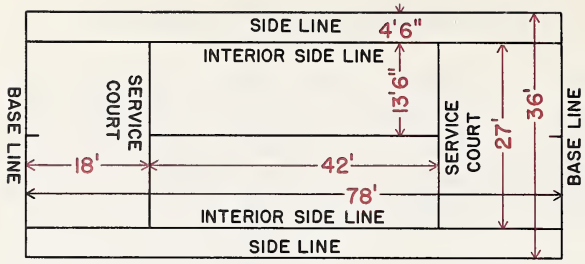
5. From the data in problem 4, what is the side of a square which has a diagonal of 7 inches?

6. The perimeter of a regular pentagon is $17\frac{1}{2}$ inches. What is the length of each side?

7. A regular hexagon is inscribed in a circle having a diameter of $4\frac{1}{2}$ inches. What is the perimeter of the hexagon?

8. One acute angle of a right triangle is 56°. How many degrees are there in the other acute angle?

9. Two angles of a triangle are 56° and 78°. How many degrees are there in the third angle of the triangle?



Drawing a Tennis Court to Scale

The picture shows a plan of a lawn tennis court drawn to **scale.** In a scale drawing, a line is usually a fractional part of the length of the line it represents.

1. One inch on the drawing of the tennis court represents how many feet?

2. What is the length of a tennis court?

3. What is the width of a tennis court between the sidelines?

4. What is the width of a tennis court between the interior side lines? (This is the part of the court which is used for "singles.")

5. What is the distance from the base line to the line which marks the edge of the service court?

6. What are the dimensions of the playing surface of a tennis court for "singles"? What is the area of this playing surface?

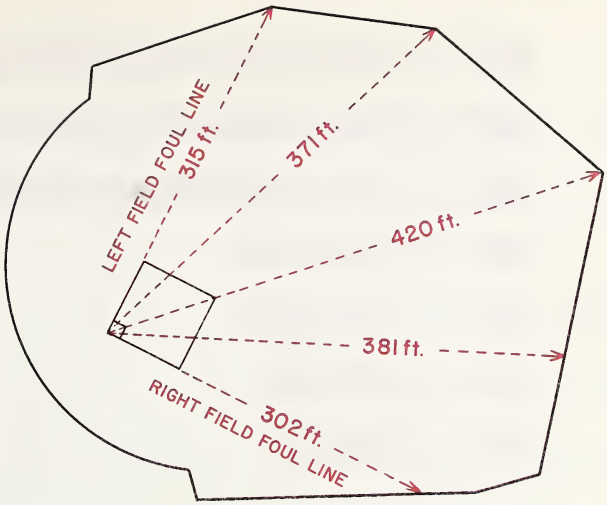
7. The entire playing surface of a tennis court is used for "doubles." What is the area of this surface?

8. If the diagram of a tennis court is drawn to a scale of $1'' = 8'$, what is the length of the line on the drawing that represents the length of the court?

9. Using the same scale as in problem 8, what is the length of the line to represent the width of the court for singles? for doubles?

10. Using the scale $1'' = 8'$, make a scale drawing of a tennis court.

★11. When the length of a line on a drawing is equal to the length of the line represented, to what scale is the drawing made?



Drawing to Scale

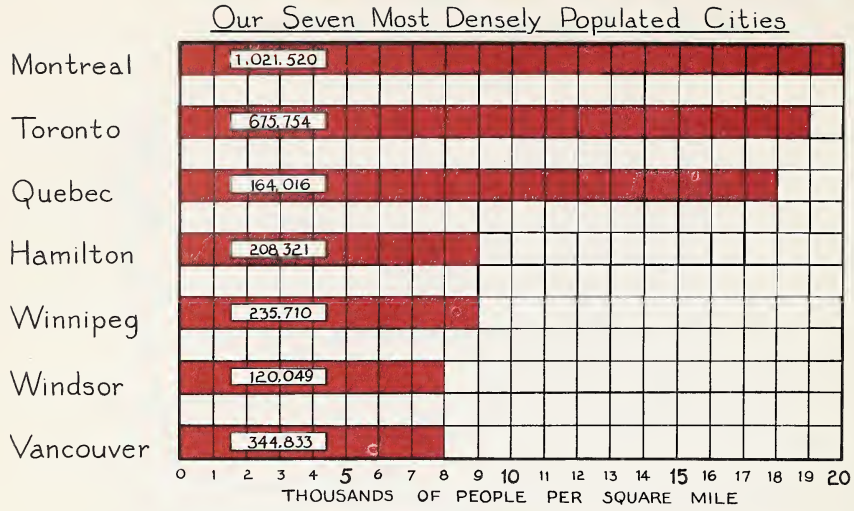
1. The diagram gives the dimensions of Fenway Park which is the home baseball field of the Boston Red Sox. Using a scale $1'' = 90'$, make a scale drawing of this baseball park.

2. The standard size of a basketball court for girls is $45' \times 90'$. To the scale $1'' = 10'$ make a drawing of a court of this size.

3. The standard size of a basketball court for high school is $50' \times 84'$. To the scale $1'' = 10'$ make a drawing of this court.

4. On the drawing for problem 3, bisect each of the two long sides. Then draw a line connecting these midpoints. This center line divides the court into halves. Bisect this center line to find the midpoint which is the center of the court. Use this point as a center and draw two concentric circles, one with a diameter representing 4 feet, and the other, with a diameter representing 12 feet. These two concentric circles indicate the position of certain players at the beginning of the game.

5. The field for 6-man football is 330 feet long and 195 feet wide. If the field extends 30 feet beyond each goal line, what are the dimensions of the playing field? Make a scale drawing of the field, using a scale $1'' = 50'$.



Our Seven Most Densely Populated Cities

The graph shows the average number of people per square mile in the seven most densely populated cities of Canada. The number of people per square mile in a city is used as a measure of the **DENSITY** of the population of that city.

1. One square on the scale represents how many people?

2. The length of the graph to represent the population density of Winnipeg is what part of the length of the graph to represent the population density of Toronto?

3. The approximate area of each city is as follows:

Montreal, 50.4 sq. mi.; Toronto, 34.9 sq. mi.; Quebec, 9.0 sq. mi.; Hamilton, 22.0 sq. mi.; Winnipeg, 25 sq. mi.; Windsor, 14.9 sq. mi.; Vancouver 43.7 sq. mi.

To the nearest thousand, find the population of each city.

4. The density of population of Canada's newest Province, Newfoundland, is 2.44 persons per square mile. If the area of the province is 147,994 square miles, what is the approximate population of the province?

★5. What is the density of population of your province?

Drawing Bar Graphs

The instructions below should be followed in drawing bar graphs. Show that these points were observed in making the graph on page 246.

A. Decide whether the bars are to extend vertically or horizontally.

B. Select a suitable scale for the graph.

C. Round off each number to be graphed so that there are not more than three figures other than zero. Thus, 1,723,465 should be rounded off to 1,720,000 or to 1,700,000.

D. To find the number of squares or spaces for each bar, divide the number to be graphed by the scale value.

E. If there is no regular time interval, arrange the items according to numerical value.

F. Make the bars of uniform width. These bars may be shaded.

G. Leave a space of uniform width between bars.

H. Try to have the graph present a true picture by beginning the scale at zero.

Make bar graphs to show the following data:

1. Total motor car registrations during four recent years in Newfoundland were: Nineteen forty-nine, 9000; Nineteen fifty, 11,000; Nineteen fifty-one, 13,500; Nineteen fifty-two, 15,000.

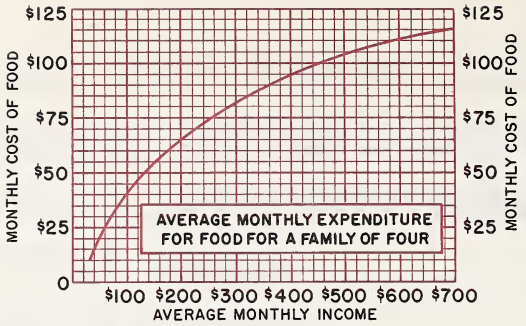
2. The growth of population of Canada in four 10-year intervals was as follows:

1911-21, 1.58 million;	1931-41, 1.13 million;
1921-31, 1.59 million;	1941-51, 2.50 million.

3. The number of points scored in recent Olympic games by each of the countries listed was as follows:

United States, 662	France, 230	Italy, 183
Sweden, 353	Hungary, 202	Great Britain, 170

★4. From a *Canada Year Book* or some other source book, find the area of the four largest provinces of Canada and graph the data. Do the same for the four smallest provinces.
the Mississippi River.



Budgeting for Food

1. What does the vertical scale represent? How much does each small square represent on this scale?

2. About how much a month did a family of four spend for food when the monthly income was $100? $200? $300? $400? $600?

3. About what was the average monthly income for a family of four when the expenditure for food was $50? $75? $90? $100?

4. About what was the amount spent for food each month when the yearly income was $1800? $2400? $3000?

5. When the family income was $200 a month, approximately what per cent of this income was spent for food?

6. If the family income doubled, did the cost of food likewise double? Why? Use the graph to prove your answer.

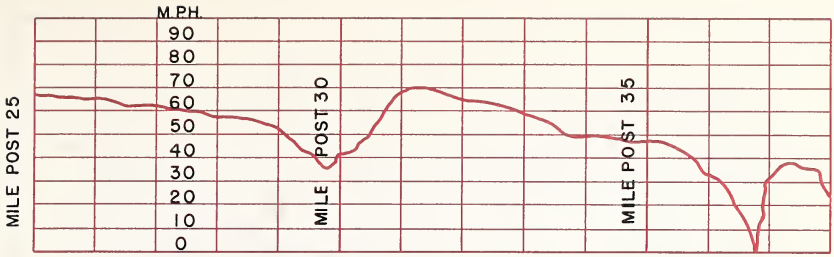
Practising Percentage

Find the missing number in each of the following:

	a	b	c
1.	7% of 450 = ?	36 = ?% of 45	15 = 3% of ?
2.	1.5% of 1240 = ?	240% of 320 = ?	84 = ?% of 25
3.	600 = 150% of ?	20 = 4% of ?	37 = ?% of 50
4.	$\frac{1}{2}$% of 980 = ?	$\frac{3}{4}$% of 1800 = ?	125 = 20% of ?
5.	3 = 1% of ?	720 = ?% of 400	25 = ?% of 1000

6. 75 is what per cent greater than 60?

7. 120 is what per cent less than 150?



Recording the Speed of Trains

Many locomotives are equipped with speed recorders. These instruments record the speeds of trains on graph paper as shown above.

1. Which numbered mileposts are represented on the graph? What is the distance between one numbered milepost and the next numbered milepost?

2. According to the graph what was the approximate speed of the train when it passed milepost 25? When it passed milepost 30?

3. There is a curve in the track about $\frac{1}{4}$ mile before milepost 30. Approximately what was the speed of the train when it passed this curve?

4. What was the greatest speed the train reached on the part of the trip shown?

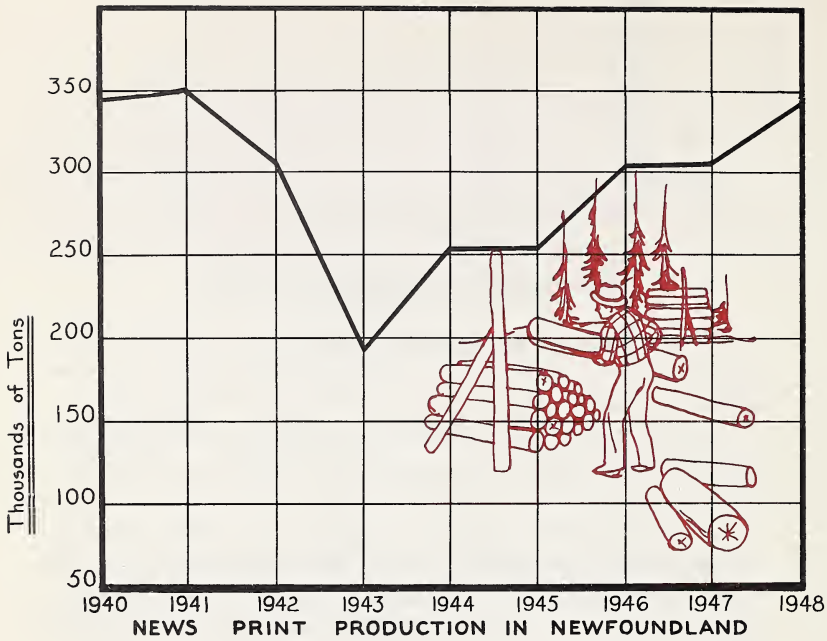
5. Approximately how far from milepost 30 did the train come to a stop?

6. If the average speed between mileposts 25 and 30 was 50 m.p.h., how many minutes did it take the train to travel this distance?

7. If the average speed between mileposts 30 and 35 was 45 m.p.h., how many minutes did it take the train to travel this distance?

★8. Find the number of minutes it takes a train to travel 10 miles at an average speed of 40 m.p.h.; of 48 m.p.h.; of 75 m.p.h.; of 90 m.p.h.

★9. In case of a train wreck, why would a record of the speed of the train be important in helping to determine the cause of the accident?



Newsprint Production in Newfoundland

The largest paper mill in the world is at Corner Brook, on the west coast of Newfoundland. Millions of logs, drawn from the back country timber limits, feed the giant mill which turns out newsprint.

1. On the graph, what does the line represent?
2. In which year was the production of newsprint greatest?
3. Approximately how many tons of newsprint were produced in 1940, 1943, 1946, 1948?
4. During what two year period was the increase in production the greatest?
5. How did World War II, as shown on the graph, affect the Newfoundland newsprint production?
6. Approximately what percentage is the lowest production of the highest production during the eight year period?

★7. Find out the production of newsprint in Newfoundland during each of the years since 1948.

Drawing Line Graphs

Observe the following instructions in drawing line graphs:

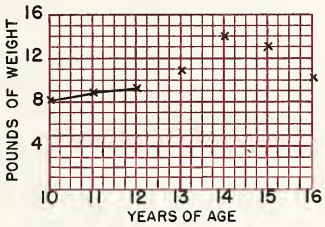
A. Use ruled paper. Mark off a convenient scale on the line which shows the horizontal scale and also on the line which shows the vertical scale. See the graph below.

B. Mark the different points to be represented on the graph. To locate a point, such as the point to show a growth of 9 pounds at age 12, find 9 on the scale to show weight and 12 on the scale to show age. Follow the lines from each of these two points to their point of intersection. Find this point on the graph below.

C. Connect the points marked in order with straight lines.

D. Give the graph a caption or title.

1. The graph showing the average annual gain in weight of boys of certain ages is partly drawn. Make a copy of the graph and complete it.



2. The average annual gain in weight of girls of certain ages is as follows: Age 10, 8 lb.; age 11, 10.5 lb.; age 12, 12 lb.; age 13, 10 lb.; age 14, 9.5 lb.; age 15, 6.5 lb.; age 16, 3 lb. Show the data on the graph which you made for problem 1, using a different color or a different type of line.

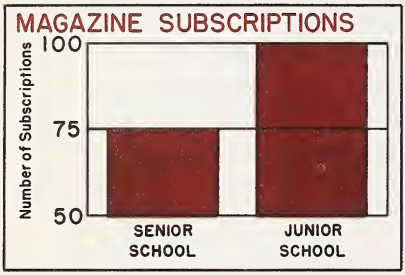
3. Weights for well-fed steers of different ages are as follows:

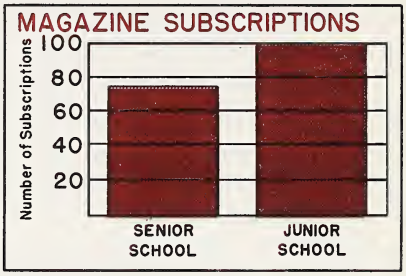
Age	Weight	Age	Weight	Age	Weight
Birth	80 lb.	12 mo.	850 lb.	24 mo.	1300 lb.
6 mo.	450 lb.	18 mo.	1100 lb.	30 mo.	1475 lb.

Show the data by a broken line graph.

Be Sure to Read a Graph Correctly

The students of the junior high school in Claremont entered a contest with the students of the senior high school to see which group could sell more subscriptions to magazines. At the end of the first week of the contest, some of the students of the junior school made a graph like the graph given on the left below to show the record of the two groups. The graph on the right shows the same facts when the scale begins at zero.





1. In the graph on the left, compare the heights of the two bars. The height of the shorter bar is approximately what fractional part of the height of the longer bar?

2. According to the lengths of the bars on the left, the number of subscriptions the juniors sold is what per cent more than the number the seniors sold?

3. The height of each bar on the right shows the number of subscriptions each group sold. Without reading the scale, tell about what fractional part of the height of the shorter bar the height of the longer bar is.

4. Use the graph on the right to find what per cent the number of subscriptions the seniors sold is of the number the juniors sold.

5. At what number does the scale begin on the graph on the left? on the graph on the right?

A graph usually gives a more nearly correct picture if the graph begins at zero than if it begins at some other number.

★6. Find some graphs in books, magazines, or newspapers. See if the scales on these graphs begin at zero.

Getting Ready for the Progress Test in the Fundamentals

I. Add:

1. 968 / 7346 / 87 / 509 / 4635 / 94

2. .77 / .58 / .39 / .07 / .86

3. $7\frac{1}{4}$ / $2\frac{3}{8}$ / $9\frac{1}{2}$ / $4\frac{7}{8}$

4. $\frac{5}{6}$ / $\frac{3}{4}$ / $\frac{1}{2}$ / $\frac{2}{3}$

5. 4 lb. 9 oz. / 3 lb. 8 oz.

6. 7 min. 38 sec. / 2 min. 25 sec.

II. Subtract:

1. 4002 − 3146

2. 54,108 − 38,259

3. .745 − .658

4. .025 − .018

5. 9 − $3\frac{7}{8}$

6. $7\frac{1}{2}$ − $4\frac{5}{6}$

7. $18\frac{2}{3}$ − $9\frac{3}{4}$

8. 6 hr. 15 min. − 4 hr. 25 min.

9. 6 pt. 10 fl.oz. − 5 pt. 12 fl.oz.

III. Multiply:

1. 708 × 7

2. 456 × 80

3. .609 × 308

4. 46 × 29

5. 7.8 × 3.5

6. 75 × $8\frac{3}{4}$

7. 97 × 3.8

8. $87\frac{1}{2}$ × 9

9. 4 ft. 9 in. × 3

10. $\frac{3}{8} \times 1\frac{1}{2} =$

11. $\frac{5}{6} \times 1\frac{1}{2} \times 4\frac{1}{2} =$

12. $\frac{7}{8} \times 2\frac{1}{4} =$

13. 6% of 430 =

14. $\frac{1}{4}$% of 980 =

15. 3.4% of 1250 =

IV. Divide:

1. $6\overline{)3725}$

2. $18\overline{)91445}$

3. $460\overline{)35425}$

4. $.05\overline{)8}$

5. $1.2\overline{).66$

6. $4\overline{)14}$

7. $\frac{3}{4} \div \frac{5}{8} =$

8. $1 \div \frac{9}{16} =$

9. $2\frac{1}{2} \div 3\frac{1}{4} =$

10. $4\frac{1}{2} \div \frac{7}{8} =$

11. $5\overline{)12 \text{ ft. } 8 \text{ in.}}$

12. 27 = ?% of 50

13. 32 = ?% of 25

14. 10 = 4% of ?

The Vocabulary of Arithmetic

Define, illustrate, or use in a sentence each of the terms given below. The number in parentheses shows where the term is introduced.

Axis of symmetry	(238)	Perpendicular bisector	(229)
Coincide	(236)	Polygon	(233)
Congruent	(236)	Quadrilateral	(241)
Equivalent	(237)	Regular polygon	(233)
Hexagon	(233)	Rhombus	(241)
Inscribed polygon	(233)	Scale drawing	(244)
Pentagon	(234)	Symmetry	(238)

Number Quickies

1. The product of two numbers is 144. If one of the numbers is 16, what is the other number?

2. A half-pint bottle of cream sells for 33¢. At that rate, what is the cost of a gallon of cream in half-pint bottles?

3. The average of three numbers is 78. If two of the numbers are 69 and 84, what is the third number?

4. How many thousands are there in 1.5 million?

5. What is the sum of the numbers from 1 to 9, inclusive?

6. Two angles of a triangle are 49° and 67°. How many degrees are there in the third angle?

7. A parallelogram has a base of 8 in. and an altitude of 5 in. If a diagonal is drawn, what is the area of each triangle?

8. What is the length of the longest straight line which can be drawn in a circle having a radius of $2\frac{1}{2}$ in.?

9. How many diagonals is it possible to draw from any vertex of a pentagon?

10. There are two tablespoonfuls in a fluid ounce. How many tablespoonfuls are there in a pint?

11. What is the first three-place whole number which is divisible by 6?

12. How many centimeters are there in 3.45 meters?

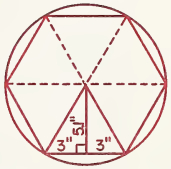
Chapter Test

1. What is meant by constructing a figure?

2. Draw a line $2\frac{1}{2}$ inches long and construct the perpendicular bisector of this line. Check the accuracy of your construction with your ruler and protractor.

3. Draw an isosceles triangle which has base angles of 65° each. How many degrees are there in the vertex angle? Bisect the vertex angle. If your construction is correct, the bisector of this angle is the perpendicular bisector of the base of the triangle.

4. Inscribe a regular hexagon in a circle having a diameter of 3 inches. What is the perimeter of the hexagon?



5. What is the area of the regular hexagon shown on the left above?

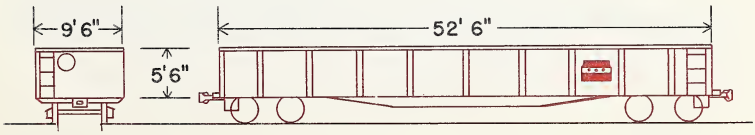
6. If each vertex of a regular inscribed pentagon is connected with the center of the circle, how many degrees are there in each of the five central angles formed?

7. Make a copy of the design shown on the right above.

8. A square has an area of 36 square inches. If the length of an equivalent rectangle is 9 inches, what is the width of the rectangle?

9. How many axes of symmetry is it possible to draw in an equilateral triangle? in an isosceles triangle? in a scalene triangle?

10. The picture shows a scale drawing of a type of freight car. What is the length of the car? the width? What is the depth of the bed of the car? To what scale is the length of the car drawn?



Progress Test in the Fundamentals

Solve the following examples:

1. (8)
$$\begin{array}{r} \$\ 4.98 \\ 23.49 \\ 9.75 \\ 0.98 \\ 7.84 \\ \underline{31.65} \end{array}$$

2. (25) $7\frac{1}{3} + 6\frac{1}{2} + 2\frac{5}{6} + 8\frac{3}{4}$

3. (8) $4042 - 96$

4. (25) $12\frac{1}{2} - 5\frac{7}{8}$

5. (48) $.725 - .687$

6. (16) $38\overline{)77145}$

7. (71) $2.4\overline{).144}$

8. (69) $.08\overline{)3}$

9. (29) $\frac{5}{6} \times 3\frac{1}{4} =$

10. (34) $\frac{7}{8} \div 3\frac{1}{2} =$

11. (29) $1\frac{1}{2} \times \frac{2}{3} \times 5\frac{1}{4} =$

12. (90) $\frac{5}{6} = ?\%$

13. (34) $6\frac{1}{2} \div \frac{3}{4} =$

14. (92) 3.2% of $460 =$

15. (102) $\frac{3}{4}\%$ of $\$680 =$

16. (92) 125% of $96 =$

17. (98) $14 = ?\%$ of 25

18. (98) $125 = ?\%$ of 75

19. (108) $7 = 2\%$ of $?$

20. (108) 160% of $? = 40$

If you did not understand how to solve an example, turn to the page number in parentheses where the process is explained.

★For Those Who Made No Error on the Above Test

Which of the following statements are true? Which are false? Give an illustration to justify your answer.

1. A bisector of a line is always at right angles to the line.

2. The bisector of an angle of a triangle also bisects the side opposite the angle.

3. Two lines perpendicular to the same line are parallel.

4. The sum of two sides of a triangle is greater than the third side.

5. If a rectangle and a parallelogram are equivalent, the two figures must have equal bases.

6. If two angles of one triangle are equal to two angles of the other triangle, the third angle of one triangle must be equal to the third angle of the other triangle.

7. A radius of a circle is an axis of symmetry of the circle.

Test in Problem Solving

Solve the following problems. If you are unable to solve a problem, turn for help to the page indicated on the right.

1. A batter made 14 hits out of 45 times at bat. What was his batting average? (68)

2. Goods listed at \$750 are sold at discounts of 20% and 5%. Find the net cost of the goods. (120)

3. A sweater was sold for \$6 which was 75% of the regular price. What was the regular price? (108)

4. What is the area of a circle 6 feet in diameter? ($\pi = 3.14$) (152)

5. A bank discounted a 90-day note for \$450 at 6%. What were the proceeds? (172)

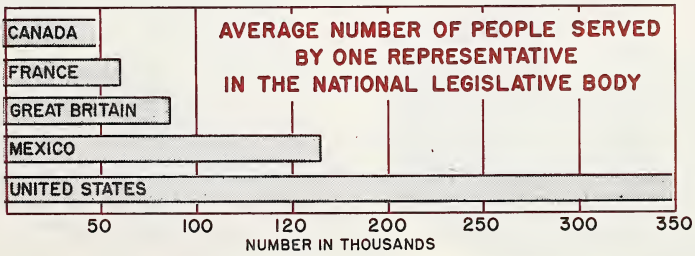
6. The semiannual interest on a loan of \$250 was \$7.50. What was the rate of interest? (169)

7. What is the market value (without brokerage) of 100 shares of stock selling at $46\frac{3}{4}$? (206)

8. A \$7500 house is mortgaged at 80% of its value. What is the semiannual interest on the mortgage at 5%? (180)

9. Construct a regular hexagon in a circle having a diameter of $2\frac{1}{2}$ inches. What is the perimeter of the hexagon? (233)

10. The graph shows the average number of persons served by one member in the national legislative bodies in five different countries. On the average, approximately how many persons are represented by each member of the legislative body in Canada? in France? in Great Britain? in Mexico? in the United States? (246)



57 43
ARSENAL
5

CHAPTER VIII

Volume

The figures studied in previous chapters have only two dimensions, width and length, and are called **plane figures.** Most of the pictures on page 258 show objects which have three dimensions. Objects in three dimensions have width, length, and depth or thickness. Figures which have three dimensions are called **solids.**

1. Identify each of the following solids shown on page 258:

cone, cylinder, pyramid, rectangular solid, sphere

2. One boy has an ice cream cone. What shape is the ball of ice cream at the top of the cone which the boy is holding?

3. One picture shows a boy writing at a desk. Is the surface of the desk a plane or a solid? Is the side of the paper on which he is writing a plane or a solid?

4. Name two objects on the desk which are solids.

5. Is a book a plane or a solid? Is a page of print a plane or a solid?

6. Name three objects not including a basketball which have the shape of a sphere.

7. Name five objects not including the girl's handbag which can have the shape of a cylinder.

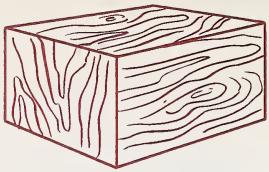
8. State which of the following are solids and which are plane figures:

a. chimney of a house
b. cross section of a log
c. movie on a screen
d. salad bowl
e. inside of a window to be washed
f. wheel

9. Is a baseball diamond a plane figure or a solid? Give a reason for your answer.

10. Is your classroom a plane figure or a solid? Name some plane figures in your classroom.

★11. What is the unit of measurement of a plane figure? Why cannot this unit be used for measuring a solid?



A Prism

The wooden block above is a rectangular solid or **prism**. Each surface of a prism is called a **face**. We may think of the prism as "resting" on one surface. We call this surface the **base** of the prism. The face opposite is also called a base. In the same manner, the surface on which any solid rests is known as the base of that solid.

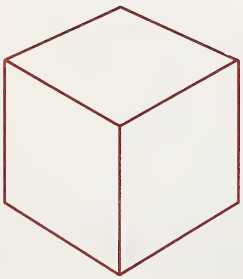
1. A prism having a rectangle for a base is called a **rectangular prism**. What name is given to a prism which has a triangular base?

2. What kind of prism does the pencil represent?

3. How many faces does a rectangular prism have? a triangular prism? a hexagonal prism?

4. How many vertices (corners) are there in a rectangular prism? (Count the number of corners of a box or of a book.)

5. If the prism at the top of this page had a square base, how many of the faces on the sides, not bases, would be congruent?



6. The prism on the left is a **cube**. All of the dimensions of a cube are equal. How may a rectangular prism differ from a cube?

7. How many faces has a cube? What kind of figure is each face of a cube? How many faces of a cube are congruent?

8. Show that in the illustrations of prisms given on this page, each face, except the bases, is a rectangle.

How Many Ice Cubes?

1. How many ice cubes are there in one row of this tray?

2. How many rows of cubes are there in one tray?

3. How many ice cubes are there in one tray?

4. If a refrigerator has 4 trays of ice cubes of the same size as shown, how many ice cubes do these trays contain?

5. Find the number of ice cubes in each of the following:

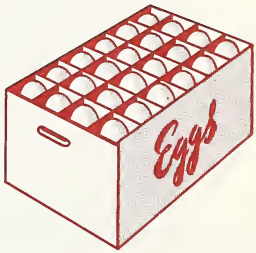
	Cubes in 1 Row	Rows	Trays
a.	7	2	4
b.	6	4	2
c.	9	2	2

	Cubes in 1 Row	Rows	Trays
d.	6	4	4
e.	10	2	3
f.	7	2	6

6. In the picture of the container of eggs, how many eggs are there in one row? How many rows are there? How many eggs are there in one layer of the crate?

7. In problem 6, how many eggs does the crate contain if it has 3 layers?

8. Find the number of eggs in each of the following crates if each has:



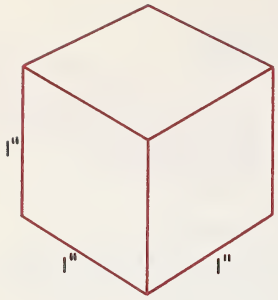
a. 6 eggs in a row, 4 rows, and 5 layers

b. 8 eggs in a row, 3 rows, and 4 layers

c. 12 eggs in a row, 4 rows, and 6 layers

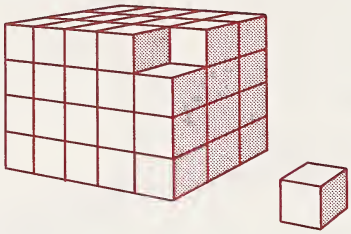
★9. Write a rule for finding the number of ice cubes a refrigerator would hold if you know the number of ice cubes in a row in a tray, the number of rows, and the number of trays of the same size.

★10. If **N** = the number of ice cubes a tray will hold, **c** = the number of ice cubes in a row of a tray, **r** = the number of rows, and **t** = the number of trays of the same size, write the formula for finding **N**. Find **N**, when **c** = 8, **r** = 3, and **t** = 2.



The Volume of a Rectangular Prism

We use square units to measure area; we use cubic units to measure **volume**. The volume of a solid means the number of cubic units, such as cubic inches, cubic centimeters, or cubic feet, which the solid contains. The volume of a cube having an edge of 1 inch is 1 cubic inch (cu. in.).



The picture shows a pile of blocks containing 1-inch cubes. (A 1-inch cube is a cube having each of its edges equal to 1 inch.)

When the extra cube is put in place:

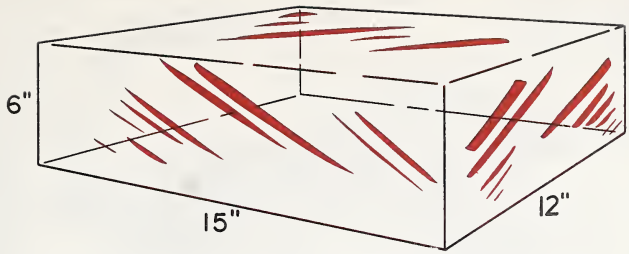
1. How many cubic inches are there in one row?
2. How many cubic inches are there in one layer?
3. How many layers of cubes are shown?
4. How many cubic inches are there in the rectangular prism?
5. What is the product of the three numbers which represent the number of inches in the length, the width, and the height?

The volume (number of cubic units) of a rectangular prism is equal to the product of length, width, and height or depth, if all of these dimensions are expressed in the same linear unit, such as inches, feet, or yards.

The formula for the volume of a rectangular prism is

$$V = lwh$$

6. What does the **V** represent? the *l*? the **w**? the **h**?



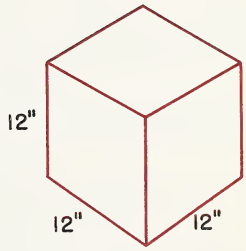
7. Find the number of cubic inches in the piece of ice shown above.

l = 15 in.	$V = lwh$, the formula
w = 12 in	$V = 15 \times 12 \times 6$
h = 6 in.	
V = ?	V = 1080

There are 1080 cu. in. in the piece of ice.

Find the volume of each of the following:

	Length	Width	Height
8.	14 in.	8 in.	$5\frac{1}{2}$ in.
9.	8 ft.	3 ft.	$1\frac{1}{2}$ ft.
10.	6 yd.	4 yd.	$2\frac{1}{3}$ yd.
11.	4 ft.	9 in.	3 ft.
12.	4.8 ft.	3.5 ft.	2.5 ft.
13.	36 cm.	28 cm.	45 cm.
14.	1.8 m.	2.5 m.	3.4 m.
15.	$2\frac{1}{2}$ ft.	$1\frac{1}{2}$ ft.	6 ft.



16. The cube, shown in the illustration, has an edge equal to 1 foot. How many cubic inches are there in a cubic foot?

17. How many 1-inch cubes are there in a 1-foot cube?

18. How many cubic centimeters are there in a cube which has an edge equal to 10 centimeters?

19. A cake of ice is 3 feet long, 2 feet wide, and 6 inches thick. How many cubic feet does it contain?

20. If a cubic foot of ice weighs 57 pounds, what is the weight of the ice in problem 19?

General Electric

A Deep Freezer

The prices of certain foods are lower during some months than during other months. This is especially true at the time fruits and vegetables are harvested. In the same manner, the price of meats and poultry varies at different times of the year when these products are plentiful. If a family purchases food at the time of low prices and stores the food in a freezing unit, a great saving is possible in the cost of food. The table gives the price of food in a recent year and the quantity which may be stored in a frozen food cabinet of a certain size.

Product	Total Weight in Pounds	Total Number of Packages	*Normal Price	Low Price	Dollar Savings	Per Cent of Savings
a. Meat	265	105	$219.95	$174.90	?	21%
b. Poultry	110	24	88.00	72.60	?	18%
c. Sea food	67	70	41.54	33.50	?	19%
d. Vegetables	336	425	141.12	104.16	?	26%
e. Fruits	272	310	87.04	68.00	?	22%
Total	?	?	?	?	?	

* The normal price is based on the average purchases of small amounts, such as a pound, whereas the low price is based on purchases of large quantities made at seasonal times of the year when prices were low.

The following problems are based on the table given on page 264:

1. How many pounds of food are listed in the table? How many packages?

2. For each item given in the table tell the total amount of savings in dollars resulting from buying at low prices rather than at normal prices; for all items.

3. If a family filled the freezing unit once a year at the low prices indicated, how much would be the total yearly savings in the cost of food? (Answer to the nearest dollar.)

4. To the nearest half pound, what is the average number of pounds in a package of meat? in a package of poultry? in a package of vegetables?

5. What is the average normal price per pound of meat? What is the low price per pound?

6. What is the average normal price per pound of vegetables? What is the average low price per pound?

7. What is the total amount at the normal cost of all of the items given in the table? What is the total amount at the low cost? (Round off the answers to the nearest dollar.)

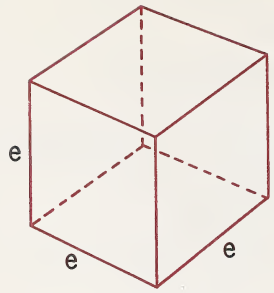
8. For which of the items is the per cent of savings, based on normal price as given, the greatest? the least?

★9. To find the per cent of savings for all of the items of food, compare the total dollar savings (problem 3) with the total of the normal prices (problem 7). To the nearest per cent, find the per cent of savings for all of the items given.

★10. Dick said that he could find the per cent of savings for all of the items given by finding the average of the given per cents. Was his statement correct? Prove your answer.

★11. Another freezing unit is able to store only half as much food as that given in the table. If the same prices per pound are used, prove that the per cents of savings would be the same as those given in the table.

★12. Find the safe temperature for the storage of food in a deep freezer.



The Volume of a Cube

A cube is a rectangular prism which has all of its edges equal. The edge of a cube is usually represented by the letter **e** as shown.

Since the formula for the volume of a prism is $V = lwh$, we may substitute **e** for each of the letters l, **w**, and **h**. Then the formula for finding the volume of a cube becomes $V = e \times e \times e$ or

$$V = e^3$$

e^3 is read **e-cube.** It means that **e** has been multiplied by itself three times. It therefore has the exponent 3. If $e = 2$, the volume of the cube is $2 \times 2 \times 2$, or 8.

1. What is the volume of a cube having an edge of 4 in.? of 6 in.? of 10 in.?

2. Find the volumes of cubes whose dimensions in feet are the whole numbers from 1 to 12. This means that you are finding the cube of each number.

3. How many faces has a cube? How many edges? How many vertices or corners?

4. Each face of a cube is what kind of figure?

5. If the edge of a cube is **e**, what is the area of one face of the cube?

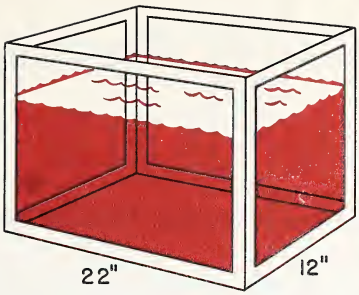
6. Prove that the formula for finding the area of all of the faces of a cube is $6e^2$.

7. Find the area of all of the faces of a cube having an edge of 2 in.; of 3 ft.; of 5 in.; of 8 cm.; of 10 cm.

8. Doubling the edge of a cube multiplies the total surface area of the cube by what number?

★9. Doubling the edge of a cube multiplies the volume of the cube by what number?

★10. A piece of ice, weighing 57 pounds, is a cube each side of which is 1 foot. At that rate, what is the weight of a cube of ice each side of which is 2 feet?



Applications of Volumes of Prisms

1. There are 277.3 cubic inches in a gallon. To the nearest whole number, how many cubic inches are there in a quart?

2. How many cubic inches are there in a cubic foot?

3. There are 277.3 cubic inches in a gallon. Prove that there are approximately 6.25 gallons in a cubic foot.

4. A cubic foot of water weighs 62.5 pounds. If there are 6.25 gallons in a cubic foot, what is the weight of a gallon of water? (Answer to the nearest tenth of a pound.)

5. The illustration shows an aquarium which is filled to a depth of 14 inches. How many cubic inches of water are there in the aquarium? Allowing 277.3 cubic inches to a gallon, how many gallons of water are there in the aquarium?

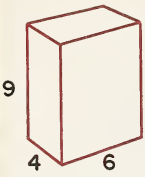
6. A bin 12 feet long and 4 feet wide is filled with wheat to a depth of 6 feet. If a cubic foot is equal to about .8 bushel, how many bushels of wheat does the bin contain?

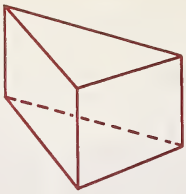
7. A contractor usually estimates the cost of excavation by the cubic yard. How many cubic feet are there in a cubic yard?

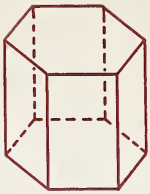
8. The inside dimensions of the bed of a truck are $9' \times 5' \times 3'$. How many cubic yards of dirt will the bed of the truck hold when level full?

★9. A cubic foot of space will hold approximately .8 bushel of grain. How many cubic feet must a bin have to hold 500 bushels?

★10. Measure your classroom and find its volume. A classroom should provide at least 30 cubic feet per pupil. Does your classroom meet this standard?







A New Formula for the Volume of a Prism

On page 262 we learned that the formula for finding the volume of a rectangular prism is $V = lwh$. In the rectangular solid given above, the area of the base is lw. Therefore, the number of units in the volume of a prism is equal to the product of the **area of the base** and the height. We may represent the area of the base by **B**. Then the formula for the volume of a prism is

$$V = Bh$$

1. In the formula $V = Bh$, what does the **B** represent? the **h**?

2. What is the area of the base of the rectangular prism given above? What is the height? What is the volume of the prism?

3. What kind of base has the right-hand prism above? If the area of the base is 24 square feet and the height is 6 feet, what is the volume of the prism?

4. Notice the prism in the middle. What kind of base has it? If the area of the base of this prism is 18 square inches and the height is 14 inches, what is the volume of the prism?

Find the volume of each of the following prisms:

	Area of Base	Height		Area of Base	Height
5.	16 sq. ft.	9 ft.	10.	48 sq. in.	12 in.
6.	36 sq. ft.	7 ft.	11.	36 sq. cm.	15 cm.
7.	56 sq. ft.	15 in.	12.	54 sq. cm.	25 cm.
8.	14 sq. ft.	5 ft.	13.	76 sq. cm.	45 cm.
9.	32 sq. in.	16 in.	14.	84 sq. ft.	9 in.

MORE PRACTICE

★15. The volume of a prism is 144 cubic inches. If the area of the base is 24 square inches, what is the height of the prism?

★16. The volume of a prism is 120 cubic inches. If the height of the prism is 8 inches, what is the area of the base of the prism?

Practise What You Have Learned

1. $\begin{array}{r} 42{,}308 \\ -609 \\ \hline \end{array}$ 2. $\begin{array}{r} 806 \\ \times 509 \\ \hline \end{array}$ 3. $\begin{array}{r} 12\frac{1}{8} \\ -5\frac{3}{4} \\ \hline \end{array}$ 4. $\begin{array}{r} 4.7 \\ \times 3.5 \\ \hline \end{array}$ 5. $275\overline{)93456}$

6. $7\frac{1}{2} \times \frac{3}{4} =$ 7. $2\frac{1}{4} \times 4\frac{1}{2} \times 3\frac{1}{7} =$ 8. $3\frac{1}{2} \div \frac{3}{4} =$

9. $.5\overline{).32}$ 10. $4\overline{)1.7}$ 11. $14\overline{)7}$ 12. $\frac{5}{8} = ?\%$

13. 4.5% of 980 = 14. 102% of 360 = 15. $33\frac{1}{3}\%$ of 480 =

16. 54 = ?% of 36 17. 15 = ?% of 7 18. 9 = 2% of ?

19. 125% of ? = 40 20. 36 = 5% of ? 21. $\frac{1}{4}\%$ of 1420 =

22. $\begin{array}{r} 4 \text{ ft. } 7 \text{ in.} \\ 9 \text{ ft. } 10 \text{ in.} \\ 1 \text{ ft. } 6 \text{ in.} \\ \hline \end{array}$ 23. $\begin{array}{r} 18 \text{ min. } 6 \text{ sec.} \\ -5 \text{ min. } 45 \text{ sec.} \\ \hline \end{array}$ 24. $\begin{array}{r} 1 \text{ pt. } 12 \text{ fl.oz.} \\ \times 3 \\ \hline \end{array}$

25. Without copying, find the sum of the following:

$$746 + 908 + 67 + 439 + 968 + 83$$

Number Quickies

1. How many seconds are there in .45 of a minute?

2. One train leaves a station at 10:49 A.M. and on the same day the next train for the same destination leaves the station at 2:21 P.M. What is the interval of time between trains?

3. An airplane flies 15 mi. in $2\frac{1}{2}$ minutes. At that rate, what is the speed of the airplane in miles per hour?

4. The average score of three tests is 88. If two of the scores are 79 and 91, what is the third score?

5. One angle of a triangle is 35° and another angle is 55°. What kind of triangle is it?

6. If living costs have increased 50% during the past five years, the costs now are how many times as much as they were five years ago?

7. A line $5\frac{3}{4}$ in. long is bisected. What is the length of each part?

8. How many minutes are there in 2.6 hours?

The Volume of a Cylinder

Each of the objects shown has the shape of a **cylinder.** A cylinder is a solid which has a curved surface, the bases of which are equal and parallel. Usually the bases of a cylinder are circles.

1. Name five objects you have seen, each of which has the shape of a cylinder.

2. On page 268 we learned that the volume of a prism is equal to the product of the **area of the base** and the height. This same rule applies to finding the volume of a cylinder. The base of a cylinder is what kind of figure? What is the formula for finding the area of this figure?

3. If we substitute πr^2 for **B** in the formula $V = Bh$, we have the formula for the volume of a cylinder. This formula is

$$V = \pi r^2 h$$

What does the **r** represent? the **h**?

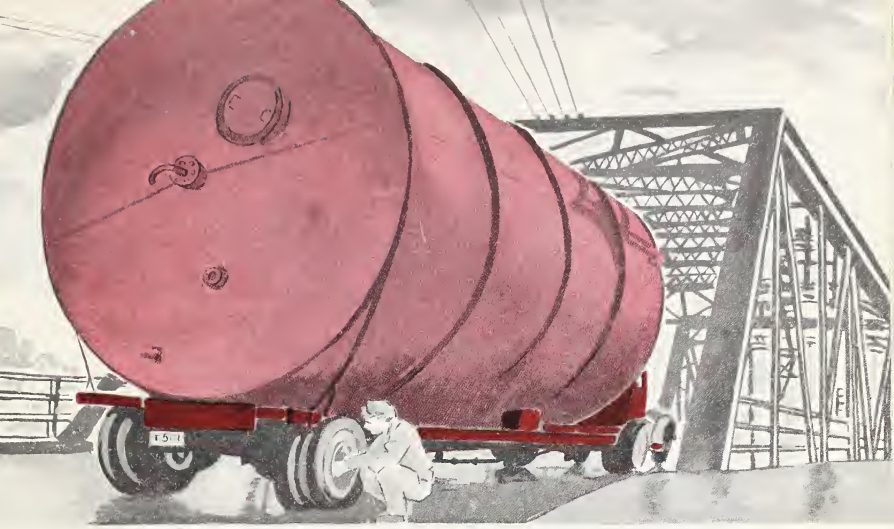
4. Find the volume of a cylinder which is 4 inches in diameter and 7 inches high.

$r = 2$	$V = \pi r^2 h$, the formula
$h = 7$	$V = 3.14 \times 2 \times 2 \times 7$
$\pi = 3.14$	$V = 87.92$
$V = ?$	

The volume of the cylinder is 87.92 cu. in.

Find the volume of cylinders which have dimensions of: (Use $\pi = 3.14$)

5. Diameter, 8 in.; height, 5 in.
6. Diameter, 6 ft.; height, 8 ft.
7. Diameter, 2 in.; height, 10 ft.
8. Diameter, 4 in.; height, 14 ft.
9. Radius, 10 cm.; height, 75 cm.
10. Radius, .5 ft.; height, 10 ft.
11. Radius, 25 cm.; height, 45 cm.
12. Radius, 14 cm.; height, 55 cm.



A Close Fit

The tank shown above is 39 feet long and 14 feet in diameter. The driver of the truck is letting air out of the rear tires so that the tank will be able to clear the bridge.

1. To the nearest foot, estimate the height of the clearance of the bridge.

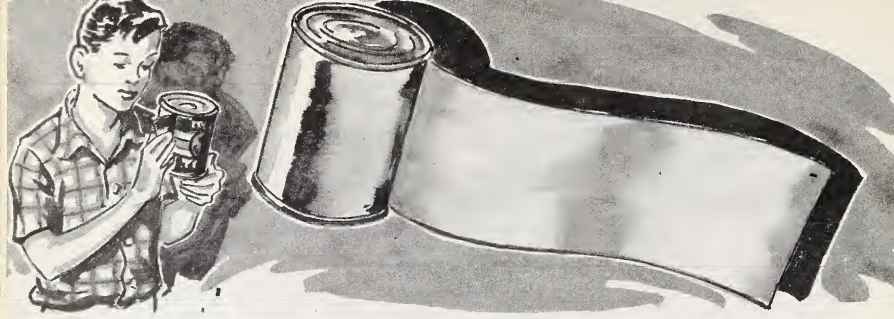
2. Assume the dimensions given above to be the inside dimensions of the tank. Prove that the capacity of the tank is approximately 6000 cubic feet. (Use $\pi = 3\frac{1}{7}$)

3. There are $6\frac{1}{4}$ gallons in a cubic foot. How many gallons are there in 6000 cubic feet?

4. The empty tank weighs 19,000 pounds. Express this amount as tons.

5. A cubic foot of water weighs $62\frac{1}{2}$ pounds. Find the weight of the tank (6000 cu. ft.) if it were filled with water. Express the amount in tons. (See problem 4.)

6. A cubic foot of a certain grade of gasoline weighs 44.8 pounds. Find the weight of the tank (6000 cu. ft.) when filled with this grade of gasoline. Express the amount in tons.



The Area of a Cylinder

1. The picture shows Bob taking the label off a can of tomatoes. The can of tomatoes is what kind of figure?

2. The label is what kind of figure? The width of the label is equal to which dimension of the cylinder?

3. The length of the label is equal to the circumference of the circle which is a base of the cylinder. What is the formula for the circumference of a circle?

4. The area of the label is equal to the **lateral** (side) **area** of a cylinder. The formula for the lateral area of a cylinder is

$$\mathbf{A} = \pi\mathbf{dh}$$

When **r** is substituted for **d** in the formula $\mathbf{A} = \pi\mathbf{dh}$, show how we get the formula $\mathbf{A} = 2\pi\mathbf{rh}$.

5. Find the lateral area of a cylinder 8 inches high if the diameter of the cylinder is 5 inches.

$\mathbf{h} = 8$	$\mathbf{A} = \pi\mathbf{dh}$, the formula
$\mathbf{d} = 5$	$\mathbf{A} = 3.14 \times 5 \times 8$
$\pi = 3.14$	$\mathbf{A} = 125.6$
$\mathbf{A} = ?$	The lateral area is 125.6 sq. in.

MORE PRACTICE

Find the lateral area of cylinders having dimensions of: ($\pi = 3.14$)

6. Diameter, 6 in.; ht., 8 in.
7. Diameter, 1 ft.; ht., 8 ft.
8. Diameter, 3 in.; ht., 15 in.
9. Diameter, 4 in.; ht., 7 in.
10. Radius, 2 ft.; ht., 10 ft.
11. Radius, 10 cm.; ht., 75 cm.
12. Radius, .1 m.; ht., 1.5 m.
13. Radius, 1 in.; ht., 7.5 in.

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PROBLEMS ON VOLUME

1. The diameter of a cylindrical bin is 18 feet and the height is 13 feet. How many cubic feet of storage space are there in the bin? ($\pi = 3.14$)

2. A storage tank has a diameter of 22 feet and is 56 feet high. How many cubic feet of space are there in this tank?

3. How many gallons of oil will be needed to fill the entire pipe in question 2, if 6¼ gallons occupies 1 cubic foot?

4. Syrup in a large drum 5 feet high and 28 inches in diameter is to be put into smaller tins which are 7 inches high and 4 inches in diameter. How many small tins can be filled from the large one?

5. An oil truck is loaded with 32 steel drums. Each drum is 6 feet high and 30 inches in diameter. If every drum is filled with oil, how many gallons of oil are there on the truck?

6. A pipe line is 6 miles long. The inside diameter of the pipe is 2 feet. Find the volume of the pipe line in cubic feet.

7. If a storage bin contains 3300 cubic feet of space, how many bushels of shelled corn can it hold? (1¼ cu. ft. = 1 bu.)

8. There are 2½ cubic feet in a bushel of corn on the cob. How many bushels of corn on the cob can be stored in a bin that has a capacity of 3300 cubic feet? a capacity of 2700 cubic feet?

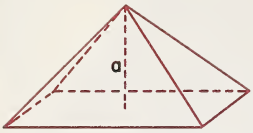
9. How many bushels of shelled corn can be stored in a bin that has a capacity of 2800 cubic feet?

10. At one place where corn is stored, there are 75 bins, each of which has a capacity of 2800 cubic feet. How many bushels of corn on the cob can be stored in all of these bins?

★11. A quarter pound of butter is 4½ inches long and 1¼ inches square. How many cubic inches are there to a pound of this butter?

★12. A cubic foot of a certain quality of granite weighs 175 pounds. Find the weight of a rectangular piece of this granite, 6 feet long, 2½ feet wide, and 4 inches thick.

★13. Measure the inside dimensions of any rectangular box. How many cubic inches does your box contain?

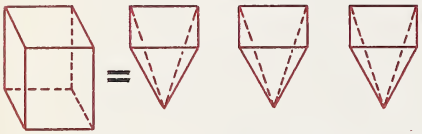


Finding the Volume of a Pyramid

The figure on the left is a **pyramid.** The base of a pyramid may be a triangle, a rectangle, or any other kind of polygon. The altitude, or height, of a pyramid is the length of a perpendicular from the vertex to the base.

1. What kind of figure is the base of the pyramid shown? Which line represents the altitude?

2. Each face of a pyramid is what kind of figure?



3. Sam and Ted used cardboard to make a hollow prism and a hollow pyramid. The bases and altitudes of the two solids are equal as shown. Sam filled the pyramid with sand and emptied the sand into the prism. He found that the prism held three times as much as the pyramid. Follow the same steps these boys took to prove that the volume of a pyramid is equal to one-third of the volume of a prism when the bases and the altitudes of the solids are equal.

4. The formula for the volume of a pyramid is

$$V = \frac{1}{3}Bh$$

What does the **B** represent? the **h**?

5. Find the volume of a pyramid having a base of 24 square inches and an altitude of 6 inches.

$B = 24$	$V = \frac{1}{3}Bh$, the formula
$h = 6$	$V = \frac{1}{3} \times 24 \times 6$
$V = ?$	$V = 48$

The volume of the pyramid is 48 cu. in.

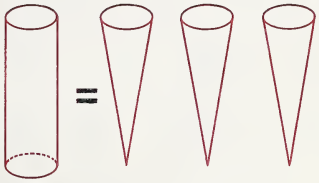
Find the volume of each of the following pyramids:

	Area of Base	Height		Area of Base	Height
6.	36 sq. in.	8 in.	8.	34.5 sq. in.	6 in.
7.	54 sq. ft.	$6\frac{1}{2}$ ft.	9.	96 sq. cm.	18 cm.

Finding the Volume of a Cone

The figure on the right is a **cone.**

On page 274 we found that the volume of a pyramid is equal to one-third of the volume of a prism when the two solids have equal bases and equal altitudes. In the same way, we can prove that a cone has a value of one-third of the volume of a cylinder if the two solids have equal bases and equal altitudes.



1. What kind of figure is the base of a cone?

2. What is the formula for the area of the figure which is the base of a cone?

3. Perform an experiment using cylinders and cones with equal heights and bases, to prove that the volume of a cone is one-third the volume of a cylinder if the bases and the altitudes of the two solids are equal.

The formula for the volume of a cone is

$$V = \frac{1}{3}Bh, \quad \text{or} \quad V = \frac{1}{3}\pi r^2 h$$

4. Why is it possible to write the formula $\frac{1}{3}\pi r^2 h$ as $\frac{1}{3}Bh$?

5. Find the volume of a cone 6 inches high if the radius of the base is 2 inches.

$r = 2$	$V = \frac{1}{3}\pi r^2 h$, the formula
$h = 6$	$V = \frac{1}{3} \times 3.14 \times 2 \times 2 \times 6$
$\pi = 3.14$	$V = \frac{1}{3} \times 24 \times 3.14$
$V = ?$	$V = 25.12$

The volume of the cone is 25.12 cu. in.

Find the volume of each of the following cones: ($\pi = 3.14$)

	Area of Base	Height		Radius of Base	Height
6.	72 sq. in.	5 in.	8.	4 in.	15 in.
7.	15 sq. ft.	4.5 ft.	9.	30 cm.	40 cm.

A Cool $2,000,000 in Cash

The refrigerator shown holds 2 million dollars if the money is arranged in packages, each containing 4000 $1 bills.

1. How many packages, each containing $4000, are needed for a total value of 2 million dollars?

2. If a package of the same size as given in problem 1 contains $10 bills, what is the value of the package? How many of these packages are needed for a total value of 2 million dollars?

3. The bill of largest value in our money system is the $10,000 bill. Since the size of all our paper currency is the same, what is the value of a package having the size given above if it contains $10,000 bills?

4. The size of a package of $1 bills shown above is $3'' \times 6\frac{1}{2}'' \times 15''$. How many cubic inches are there in the package?

5. If a package of $1 bills contains $292\frac{1}{2}$ cubic inches, prove that a cubic foot will hold approximately six of these packages. At the rate of 6 packages per cubic foot, how many $1 bills can be stored in a cubic foot of space?

6. Allowing $24,000 in $1 bills per cubic foot, how many cubic feet of space are needed to hold 2 million dollars?

7. How many thousand dollars are there in a million dollars?

8. What is another name for a thousand million?

9. If a package of $1 bills contains $4000, how many packages of this amount have a value of one billion dollars?

★10. From problem 9, do you think your classroom is large enough to store a billion dollars in $1 bills? Measure your classroom to see if your answer is correct.

Practise What You Have Learned

1. $\begin{array}{r} .745 \\ .460 \\ .988 \\ .056 \\ .279 \\ \hline \end{array}$

2. $\begin{array}{r} 3\frac{1}{2} \\ 4\frac{1}{4} \\ 2\frac{7}{8} \\ 9\frac{5}{8} \\ \hline \end{array}$

3. $\begin{array}{r} 904 \\ \times 308 \\ \hline \end{array}$

4. $\begin{array}{r} 15\frac{1}{2} \\ -7\frac{5}{6} \\ \hline \end{array}$

5. $\begin{array}{r} 73{,}125 \\ -48{,}056 \\ \hline \end{array}$

6. $37\overline{)75296}$

7. $182\overline{)93746}$

8. $\frac{3}{4} \times 2\frac{1}{2} =$

9. $2\frac{1}{4} \times \frac{7}{8} \times 3\frac{1}{7} =$

10. $\frac{5}{6} \div 1\frac{1}{2} =$

11. $12 \div 3\frac{1}{2} =$

12. $14\overline{)3.22}$

13. $2.6\overline{)2.73}$

14. $\frac{1}{2}\%$ of 940 =

15. 103% of 450 =

16. 15 = ?% of 120

17. 225 = ?% of 125

18. 12 = 4% of ?

19. 150% of ? = 60

20. Without recopying, find the sum of the following:

$$456 + 1872 + 395 + 608 + 594 =$$

Number Quickies

1. A gallon of milk weighs 10.2 pounds. To the nearest tenth of a pound, what is the weight of a pint of milk?

2. How many minutes are there in 1.4 hours?

3. A bicycle marked at $50 was sold at $37.50. What was the per cent of reduction in price?

4. What is the difference between the largest and smallest four-place whole numbers which may be written with the digits 2, 4, 7, and 9?

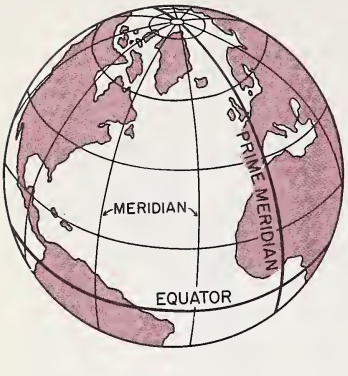
5. An electric washer sells for $245 cash or $20 down and $20 a month for a year. How much more than the cash price is the instalment price?

6. If the rate of interest is $\frac{3}{4}\%$ a month, what is the rate a year?

7. One acute angle of a right triangle is 57°. How many degrees are there in the other acute angle?

8. A regular hexagon is inscribed in a circle having a radius of 2.5 in. What is the perimeter of the hexagon?

9. A cubic foot will hold .8 bushel of grain. When level full, how many bushels can be stored in a bin $10' \times 4' \times 6'$?



The Earth Is a Sphere

A solid, such as a basketball or a marble, is a **sphere**. The earth is a sphere with a diameter of approximately 8000 miles. A globe representing the earth is a sphere.

1. What name is given to the lines which cut the equator at right angles and pass through the North and South Poles on a globe?

2. What is the name of the meridian which passes through Greenwich (near London)?

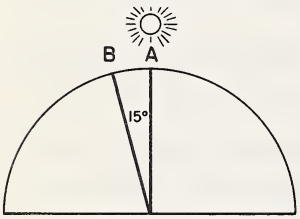
3. **Longitude** is the distance east or west measured in degrees between two meridians, one of which passes through any given point and the other through Greenwich. In which longitude are places to the east of the Greenwich meridian? In which longitude are places to the west of this meridian?

4. Is Canada in east or west longitude?

5. Is Brazil in east or west longitude?

6. How many degrees are there in a complete rotation? Therefore how many degrees of longitude pass a fixed spot in the heavens in one day?

7. Since it takes the earth 24 hours to make a complete rotation, how many degrees of longitude pass a fixed spot in one hour?

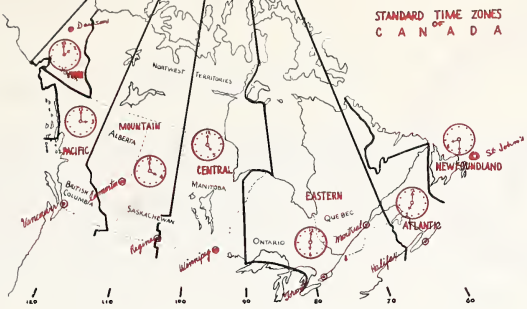


8. In the figure on the left, how many degrees west of A is B?

9. At 12 noon the sun is directly overhead at A. How many hours will it take the sun to be directly overhead at B?

10. Find the difference in time between two places when the difference in longitude between them is:

a. 30° b. 75° c. 120° d. 60° e. 45°



What Time Is It?

1. How many time zones are there in Canada?

2. How many hours difference in time are there between Toronto and Vancouver? between Winnipeg and Halifax? between Edmonton and St. John's, Newfoundland?

3. When it is 1 P.M. in Montreal, what is the Standard time in Winnipeg? in Regina? in Dawson?

4. Suppose your watch is set to standard time as you board a plane at Vancouver. If you do not reset your watch until you have arrived in Montreal, will you set the watch ahead or back to have standard time in Montreal?

How many hours of change will there be?

5. If the broadcast of the Grey Cup game in November begins at 2 P.M. E.S.T. in Toronto, what time must you tune in to get the beginning of the broadcast if you live in Edmonton? in Winnipeg? in Regina? in Vancouver? in St. John's, Newfoundland?

6. An airplane left St. John's at 9 A.M., N.S.T. and landed at Toronto at 2 P.M., E.S.T. If there was one stop of 30 minutes on the way, what was the number of hours the airplane was in the air between the two cities?

7. The difference in longitude between London and Montreal is approximately 75°. When it is now in London, what time is it in Montreal? in Halifax? in Winnipeg? in Regina? in Vancouver?

8. What time is it in London when it is now in Winnipeg? in Edmonton? in St. John's, Newfoundland?

★9. From an encyclopedia or some other source, look up the history of standard time.

The 24-Hour Clock

The Army, Navy, and Air Force express time on a 24-hour clock. Time is written with a four-place number without any punctuation. Thus, 8:25 A.M. is written as 0825, but 8:25 P.M., which is 12 hours later, is expressed as 2025. Midnight is written as 2400 and 1 minute after midnight is written as 0001.

12-Hour Clock Hour	24-Hour Clock A.M.	P.M.
1:00	0100	1300
2:00	0200	1400
3:00	0300	1500
4:00	0400	1600
5:00	0500	1700

1. The table on the right gives some of the 12 hours on a 12-hour clock and the corresponding hours as expressed on a 24-hour clock. Copy the table and complete it for the 12 hours of a clock.

2. When time is expressed on a 24-hour clock, how is it possible to tell whether corresponding time on a 12-hour clock is A.M. or P.M.?

3. Express each of the following on a 24-hour clock:

a. 2 A.M. b. 10:30 A.M. c. 10:30 P.M.
d. 4:15 A.M. e. 4:15 P.M. f. 2:05 P.M.

4. Express each of the following times given on a 24-hour clock as the same time on a 12-hour clock:

a. 1500 b. 0930 c. 0030 d. 0945
e. 1250 f. 1620 g. 2310 h. 0040

5. If an airplane departed from a base at 0600 and travelling south landed at the next base at 0825, how long (in time) was the flight?

★6. The scheduled time for a flight is 2 hr. 30 min. If the time of departure on a flight due north is 1440, at what time should the airplane reach its destination?

★7. What is the time in hours and minutes from 1140 to 1310? from 0855 to 1010? from 2330 to 0215 on the following day?

Measuring Solids

Volume is expressed in cubic units, such as cubic inches, cubic feet, or cubic centimeters. Other names are sometimes used to express the volume of special solids.

1. A linear (line) unit is used for measuring distance. What kind of unit is used for measuring area? for measuring capacity or volume?

2. What would be a suitable unit for expressing the area of a page of this book? the area of your classroom? the area of a farm? the area of your state?

3. What would be a suitable unit for expressing the capacity of a pan? of a swimming pool? the volume of a storage bin?

4. We measure wood by the **cord**. The figure below shows the dimensions of a pile of wood which contains a cord. How many cubic feet are there in a cord?

5. In certain places, the size of a cord of wood for making pulp for paper is $4' \times 5' \times 8'$. A cord of this size contains how many more cubic feet than a standard cord? A cord of wood for pulp is what per cent greater than a standard cord of wood?

6. At the rate of 45 pounds per cubic foot, what is the weight of a standard cord of wood? (Express answer to the nearest 100 pounds.)

7. A cylindrical storage bin for oats, is 14 feet in diameter (inside dimension) and 20 feet high. When the bin is level full, how many cubic feet of oats does it contain? $(\pi = \frac{22}{7})$

8. A rectangular bin is 15 feet long, 6 feet wide, and 8 feet deep. Allowing .8 bushel per cubic foot, how many bushels does the bin contain when it is level full?

Measuring Lumber

"This log contains about 1500 **feet** of lumber," said the lumberman. He used the word "feet" but he meant **board feet**. A board foot is a board having the dimensions shown.

When a board is less than 1 inch thick, it is measured as if it were 1 inch thick. For example, lumber for floors may be $\frac{5}{8}$ inch thick. The number of board feet of lumber for boards of this thickness is the same as if the boards were 1 inch thick. On the other hand, a board 2 inches in thickness has 2 layers of board feet thickness.

1. Find the number of board feet in a piece of lumber 2 inches thick, 8 inches wide, and 15 feet long.

Thickness, 2 in.
Width, 8 in. $= \frac{2}{3}$ ft.
Length, 15 ft.

No. of board feet (bd. ft.) =
No. of inches in thickness $\times$ width in feet $\times$ length in feet.
No. of bd. ft. $= 2 \times \frac{2}{3} \times 15 = 20$

The board contains 20 bd. ft.

Find the number of board feet of lumber in each of the following pieces of lumber:

	Thickness	Width	Length		Thickness	Width	Length
2.	1 in.	6 in.	12 ft.	**5.**	$\frac{5}{8}$ in.	3 in.	16 ft.
3.	4 in.	4 in.	24 ft.	**6.**	$\frac{7}{8}$ in.	6 in.	24 ft.
4.	2 in.	16 in.	18 ft.	**7.**	$1\frac{1}{2}$ in.	15 in.	30 ft.

8. The illustration on the left shows a cross section of a piece of lumber known as a "2 by 4." How many board feet are there in 50 of these pieces, each 15 feet long?

9. The price of lumber is usually stated as a certain amount per 1000 (M) board feet. Find the cost at \$80 per M of 20 boards 2 inches thick, 15 inches wide, and 14 feet long.

★10. The floor of a room is 12 feet wide and 18 feet long. If boards on the floor extend the length of the floor, how many boards 18 feet long and 3 inches wide would it take to cover the floor? If the boards are $\frac{5}{8}$ inch thick, find the cost of the flooring at \$180 per M.

★11. The cross section of an oak beam is a square 9 inches on a side. At 48 pounds per cubic foot, what is the weight of the beam when its length is 24 feet? (Answer to the nearest 10 pounds.)

★12. What is the number of board feet in the beam in problem 11? At \$120 per M, what is the value of the beam?

★13. The cross section of one beam is a square 6 inches on a side and the cross section of another beam is a square 12 inches on a side. The length of each beam is the same. The number of board feet in the larger beam is how many times the number of board feet in the smaller beam?

Practise What You Learned in Per Cent

1. Express each of the following as per cents:

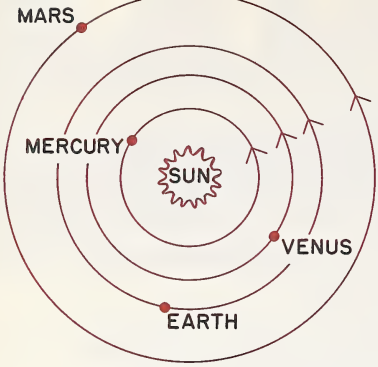
a. $\frac{7}{8}$ b. 1.2 c. $\frac{4}{5}$ d. .025 e. $1\frac{1}{4}$ f. 1.025

2. Express each of the following as common fractions or as whole numbers:

a. 75% b. 300% c. 80% d. $66\frac{2}{3}\%$ e. $37\frac{1}{2}\%$ f. 15%

	a	b	c
3.	4.5% of 260 =	102% of 450 =	8 = 2% of ?
4.	$\frac{1}{5}\%$ of 750 =	30 = ?% of 24	110% of ? = 165
5.	16 = ?% of 80	1 = ?% of 200	75 = 3% of ?

6. What number is $66\frac{2}{3}\%$ more than 210?
7. What number is $33\frac{1}{3}\%$ less than 240?
8. What is the number when 150% of it is 450?
9. What is the number when 200% of it is 150?
10. What is the number when 140% of it is 5.6?



Part of the Solar System

The sun and its nine planets are the main parts of the solar system. The planets, of which the Earth is one, revolve about the sun. The path a planet takes in its revolution is called its **orbit**. The table gives some facts about the four planets nearest the sun.

Planet	Distance from the Sun in Million Miles	Approximate Diameter	Time of Revolution	Speed in Miles per Second
Mercury	36	3000 mi.	88 da.	29.7
Venus	67	7700 mi.	225 da.	21.7
Earth	93	7920 mi.	$365\frac{1}{4}$ da.	18.5
Mars	142	4340 mi.	687 da.	15.0

1. Which of the four planets is nearest the sun? Which is farthest from the sun?

2. Which of the four planets is smallest? Which is largest?

3. To the nearest 100 miles, find the speed in miles per hour of:

   a. Mercury b. Venus c. The Earth d. Mars

4. The distance from Mars to the sun is approximately how many times as great as the distance from Mercury to the sun?

5. A year on a planet is estimated by the time it takes to make a complete revolution in its orbit. A year on Mars is approximately equal to how many years on Mercury?

6. A year on the Earth is equal approximately to how many years on Mercury?

7. The distance from the earth to the moon is about 240,000 miles. If a rocket has a speed of 3200 m.p.h., approximately how many hours would it take the rocket to travel this distance?

8. Use the table on page 284 to decide which of the following statements are true and which are false.

a. The closer a planet is to the sun, the greater the speed of the planet.

b. The farther away a planet is from the sun, the greater the size of the planet.

c. The greater the diameter of a planet, the greater the time for a revolution about the sun.

d. The greater the distance a planet is from the sun, the greater the time the planet takes to complete a revolution.

9. Light travels about 186,000 miles per second. At that rate, to the nearest million miles, how far does light travel in one minute?

★10. To the nearest minute, how many minutes does it take light to travel from the sun to Mercury? to Venus? to the Earth?

★11. The arrows on the diagram show the direction of travel of the planets in their orbits. Do the planets travel clockwise (in the direction of the hands on a clock) or counterclockwise?

★12. What are the names of the five planets which are not given on page 284?

★13. Which of the nine planets has the largest diameter?

The Vocabulary of Arithmetic

Define, illustrate, or use in a sentence each of the terms given below. The number in parentheses shows where the term is introduced.

Board foot	(282)	Prism	(260)
Cone	(275)	Pyramid	(274)
Cord	(281)	Rectangular prism	(260)
Cube	(260)	Solid	(259)
Cylinder	(270)	Sphere	(278)
Lateral area	(272)	Time Zone	(279)
Longitude	(278)	Triangular prism	(260)
Prime meridian	(278)	Volume	(262)

Getting Ready for the Progress Test in the Fundamentals

I. Add:

1. 1486 / 975 / 3458 / 709 / 4643 / 874

2. $7\frac{1}{3}$ / $3\frac{5}{6}$ / $8\frac{1}{2}$ / $6\frac{1}{4}$

3. .76 / .95 / .48 / .80

4. 7 ft. 5 in. / 3 ft. 9 in. / 6 ft. 4 in.

5. 16 min. 21 sec. / 9 min. 35 sec. / 45 sec.

II. Subtract:

1. 7432 − 58

2. 40,325 − 10,956

3. 72,010 − 3,857

4. 5 pt. 8 fl.oz. − 3 pt. 10 fl.oz.

5. .735 − .495

6. .070 − .065

7. 8 − $3\frac{2}{3}$

8. $12\frac{1}{4} - 5\frac{7}{8}$

9. 9 lb. 4 oz. − 6 lb. 10 oz.

III. Multiply:

1. 746 × 8

2. 379 × 6

3. 456 × 37

4. 905 × 405

5. 670 × 80

6. 3.5 × .35

7. 84 × .07

8. 43.5 × 9.2

9. .015 × .4

10. 3 qt. 1 pt. × 4

11. $\frac{3}{4} \times \frac{7}{8} =$

12. $3\frac{1}{2} \times 1\frac{1}{4} \times \frac{5}{6} =$

13. $\frac{4}{5} \times 3\frac{1}{3} =$

14. 3% of 750 =

15. 102.5% of 960 =

16. $\frac{1}{4}$% of 1450 =

IV. Divide:

1. $6\overline{)3614}$

2. $16\overline{)6512}$

3. $38\overline{)19257}$

4. $270\overline{)82137}$

5. $.25\overline{).2}$

6. $.75\overline{)15}$

7. $.014\overline{)28}$

8. $1.2\overline{)38.64}$

9. $\frac{5}{6} \div \frac{7}{8} =$

10. $1\frac{1}{2} \div 4 =$

11. $2\frac{1}{4} \div 1\frac{1}{2} =$

12. 36 = ?% of 25

13. 7 = ?% of 50

14. 150% of ? = 36

Chapter Test

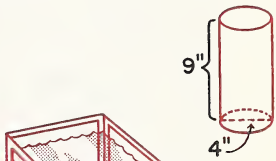
1. If a triangular prism and a triangular pyramid have equal bases and equal altitudes, the volume of the prism is how many times the volume of the pyramid?

2. If a cone and a cylinder have equal bases and equal altitudes, the volume of the cone is what fractional part of the volume of the cylinder?

3. A cube has how many faces?

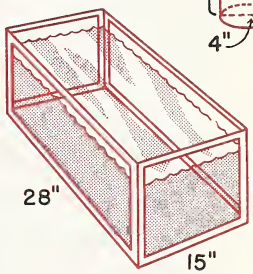
4. A cube has an edge of 3 inches. What is the total area of the cube? What is the volume of the cube?

5. What is the lateral area of the cylinder represented on the right? ($\pi = 3.14$)



6. What is the volume of the cylinder in the illustration? ($\pi = 3.14$)

7. The depth of the water in the aquarium shown on the right is 11 inches. How many gallons of water does the aquarium contain? (1 gal. = 277.3 cu. in.)



8. A bin $12' \times 7' \times 6'$ is filled level full with grain. Allowing .8 bushel per cubic foot, how many bushels are there in the bin?

9. A conic pile of sand 6 feet high has a base of 27 square feet. How many "loads" of sand are there in the pile? (1 load = 1 cu. yd.)

10. When it is 6 P.M. standard time in Vancouver (P.S.T.), what is the standard time in Regina (M.S.T.)? in Toronto (E.S.T.)?

11. The difference in longitude between London and Regina is approximately 105°. What is the difference between the time in London and the time in Regina?

12. When it is noon in Winnipeg (97° W. Long.), what time is it in London?

13. Express each of the following times on a 24-hour clock:

a. 4:15 A.M. b. 6:35 P.M. c. midnight

Progress Test in the Fundamentals

Solve the following examples:

1. (48)
$$\begin{array}{r} .645 \\ .736 \\ .804 \\ \underline{.956} \end{array}$$

2. (8) $91{,}072 - 41{,}086$

3. (11) 756×409

4. (55) 68.5×7.4

5. (25) $9\frac{1}{2} - 6\frac{7}{8}$

6. (16) $74\overline{)3796}$

7. (16) $365\overline{)94736}$

8. (71) $5\overline{)4}$

9. $7\frac{1}{3} \times \frac{5}{6} =$ (29)

10. $\frac{3}{4} \times 1\frac{1}{2} \times 3\frac{1}{7} =$ (29)

11. $\frac{4}{5} \times 6\frac{2}{3} =$ (29)

12. $3.6\overline{)18}$ (69)

13. $.15\overline{)7.5}$ (71)

14. $1.25\overline{)1.5625}$ (71)

15. 3.4% of 480 = (92)

16. $133\frac{1}{3}\%$ of 1560 = (92)

17. $\frac{1}{4}\%$ of 720 = (102)

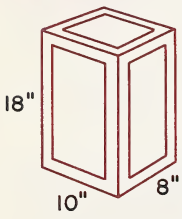
18. 34 = ?% of 25 (98)

19. 20 = 4% of ? (108)

20. 250% of ? = 75 (108)

If you did not understand how to work an example, turn for help to the page, given in parentheses, where the step is explained.

★For Those Who Made No Errors on the Above Test



The picture on the left shows a box which is a rectangular prism.

1. How many faces does the prism have on the sides? How many of these faces are equal?

2. How many bases has the prism?

3. The total area of a prism equals the sum of the area of the sides plus the area of the bases.

a. The area of the sides is the lateral area. What is the lateral area of the prism shown?

b. What is the sum of the areas of the two bases?

c. What is the total area of the prism?

4. Make a drawing of each of the following rectangular prisms and then find its total area:

a. $8'' \times 4'' \times 6''$ b. $15'' \times 6'' \times 8''$ c. $24'' \times 10'' \times 12''$

Test in Problem Solving

Solve the following problems. If you are unable to solve a problem, turn for help to the page indicated on the right.

1. A baseball player made 18 hits out of 75 times at bat. What was his batting average? (68)

2. A merchant was given discounts of 20% and 5% on goods listed at $1450. What was the net cost of the goods? (120)

3. Ted's father bought a television set at 80% of the regular price. If he paid $260 for the set, what was the regular price? (108)

4. How many days are there from March 15 to July 1? (175)

5. Mr. Harris bought 100 shares of stock at $102\frac{3}{4}$. If the brokerage was $35, what was the cost of the stock plus brokerage? (206)

6. The rate of fire insurance on a certain building is 24¢ per $100. If the rate for a 3-year policy is $2\frac{1}{2}$ times the yearly rate, find the premium of a 3-year policy of $8500 on the building. (212)

7. Draw an angle of 115° and bisect it. What kind of angle is each of the two equal angles? (229)

8. Make a scale drawing of a rug which is 9 feet by 12 feet. Use a scale $1'' = 4'$. (245)

9. Find the volume of a cylindrical storage bin which has an inside diameter of 14 feet and a height of 25 feet. ($\pi = \frac{22}{7}$) (270)

10. The area of a cube having an edge of 4 inches is how much greater than the area of a cube having an edge of 2 inches? (266)

ROSE
ERNEST

KEEP YOUR
CITY CLEAN

CHAPTER IX

Cost of Government

The pictures on page 290 show some of the services furnished to the people of Clearview. The money to pay for these services comes from **taxes**.

1. How many of the services shown on page 290 do you have in your community?

2. There is one policeman to each 750 people in Clearview, a city of 30,000 population. How many policemen are there in the city? At an average salary of $3250, what is the yearly amount paid in salaries to the policemen in this city?

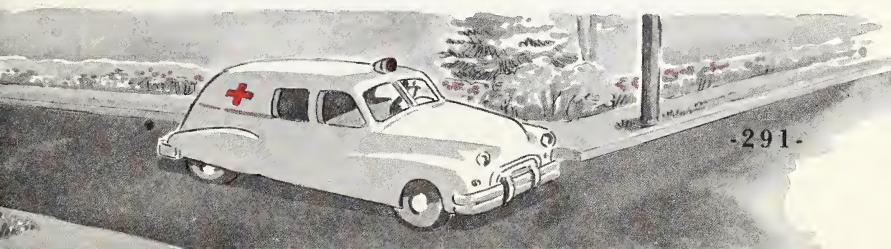
3. The average yearly cost to operate the schools in Clearview is $234 for each pupil enrolled. If the average enrollment is 1575 pupils, how much does it cost to operate the public schools in Clearview?

4. The Bartons, who live in Clearview, have three children in school. What is the average yearly cost to the city to provide school opportunities for this family?

5. The Bartons pay $350 in taxes each year. How much more does it cost Clearview to provide schooling for the Barton children than is received in taxes from this family?

6. The Bartons receive not only the services of the schools, but also other services, among them those shown in the picture. If the average yearly cost of these other services is $225, what is the total cost of the services this family receives from Clearview? This amount is how much more than the Bartons pay in taxes?

★7. In problem 6, you learned that the cost of the services the Bartons receive is much more than the amount the city receives in taxes from the family. How is the city able to operate under these conditions?



The Student Organization

A picture of the officers of the Howell School Student Organization is shown above. These officers, with a representative from each home room in the school, prepare a budget for the Student Organization for the school year. Each student who belongs to the organization pays a certain fee, called **budget dues**. When a student pays his budget dues, he receives a ticket which entitles him to free admission to all athletic contests, dramatic productions, and all other school activities for which there is a charge.

1. In the Howell School there are 500 students who belong to the "student org." If the annual budget of the organization is $425, what is the average cost per student?

2. If paid at the beginning of the school year, the budget dues are 85¢; otherwise, they are 10¢ a month for 10 months. What per cent of the cost a month may be saved by paying the dues at the beginning of the school year?

3. The admission for students to basketball games is 20¢. If a student plans to attend 6 games, how much can he save by belonging to the student organization rather than paying the admissions to each game?

4. It is not compulsory to belong to the student organization. If the number of students who belong to the organization decreases, and the amount of the budget remains the same, how would this condition affect the amount paid as budget dues?

5. Carol said, "The budget dues are too high." Jim said, "We should try to get more students to join the organization." How would Jim's suggestion affect the budget dues?

6. Suppose it is not possible to get more students to belong to the organization. Then it may be necessary to "cut" the budget in order to lower the budget dues. What does it mean to "cut the budget"? Illustrate how this may be done.

The Tax Rate

We learned that the officers of the student organization prepare a budget in order to pay for certain services provided for its members. In the same way, elected officers of a city or county prepare a budget in order to provide certain services for the people of the city or county. These officers estimate the cost of such items as fire and police protection, operation of parks and streets, and the cost of other services which the city provides. The total cost of all of these items represents the amount which is to be raised by taxes. For purposes of taxation, property is given a certain value which is called **assessed valuation**. The amount to be raised by taxation divided by the assessed valuation gives the **tax rate**.

$$\text{Tax rate} = \frac{\text{Amount to be raised by taxation}}{\text{The assessed valuation of property}}$$

1. The assessed valuation of property in a town is $2,500,000. If the amount of the town's budget is $86,000, what is the tax rate?

Budget = $86,000
Assessed value = $2,500,000
Tax rate = ?

$$\text{Tax rate} = \frac{\text{Amount of budget}}{\text{Assessed valuation}}$$

$$\text{Tax rate} = \frac{86{,}000}{2{,}500{,}000} = \frac{86}{2500} = .0344 = 3.44\%$$

The tax rate is 3.44%.

2. A tax rate of 3.44% is how much on $100 of assessed valuation? How much on $1000 of assessed valuation?

3. Express the tax rates on each of the following as per cents:

	Amount of Budget	Assessed Valuation		Amount of Budget	Assessed Valuation
a.	$37,500	$1,000,000	d.	$840,000	$30,000,000
b.	$100,000	$2,500,000	e.	$1,500,000	$40,000,000
c.	$30,000	$750,000	f.	$2,880,000	$64,000,000

4. A property valued at $12,500 is assessed at $7500. The assessed value is what per cent of the true value?

Finding Property Taxes

Most of the money raised by taxation for the support of local government comes from **real estate**, such as land, buildings, or mines. A tax on property is called a **property tax**.

A tax may be expressed in several different ways. We shall express it as a per cent or as so many dollars on $100 of assessed valuation. Thus, a tax of 3.5% is the same as a tax of $3.50 on $100 of assessed valuation. Why?

To the nearest cent, find the yearly taxes on each of the following:

	Assessed Valuation	Tax Rate		Assessed Valuation	Tax on $100
1.	$4200	3.25%	6.	$4750	$3.75
2.	$5600	4.56%	7.	$5500	$5.12
3.	$3750	3.86%	8.	$7600	$4.79
4.	$9650	4.93%	9.	$9200	$4.08
5.	$12,800	4.38%	10.	$15,500	$5.27

11. Mr. Mills has property assessed at $7200. The tax rate is $4.60 on $100 of assessed valuation. If he pays his taxes quarterly, how much is each quarterly payment?

12. In problem 11, Mr. Mills is given a 2% discount on his yearly taxes if he pays them at the beginning of the year. How much does he save by paying his taxes at the beginning of the year?

13. A city charges 8% interest on taxes which have not been paid. If a property owner owes $150 in taxes on which interest at 8% is charged, what is the interest charge for one year on the taxes?

14. A property worth $12,500 is assessed at 80% of its value. What is the tax on the property if the rate is $4.18 on $100 of assessed valuation?

★15. If a property owner decides not to pay his taxes, what legal steps can the tax collector take to collect the taxes?

★16. Mrs. Dalton said, "I do not have to pay property taxes because I rent a home." How does the tax rate affect rents?

★17. Churches, schools, and public buildings are exempt from property taxation. What does this mean?

MORE PRACTICE

386

Expressing the Tax Rate

Tax rates are usually expressed as so many mills on a dollar of assessed valuation (**a mill is 1/10¢**); this is to avoid, as far as possible, fractional per cents. A tax rate of 3.5% is equal to 35 mills on the dollar.

To change per cent to mills, multiply the rate per cent by 10; to change mills to per cent, divide the mill rate by 10,

2.58% = (2.58 × 10) mills = 25.8 mills.
46.5 mills = (46.5 ÷ 10) % = 4.65%

1. How many mills are there in one dollar?

2. Express the following tax rates in mills: 2%; 4.35%; 39.6%; 3.2 cents on $1; $1.80 on $100.

3. Express the following tax rates as per cents:
27 mills; 38.5 mills; 4.2 cents on $1; $2.90 on $100; $43.20 on $1000.

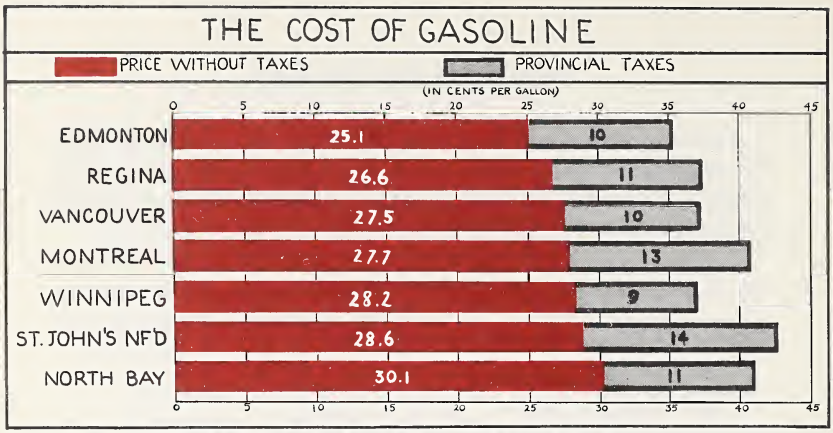
4. The school tax in a certain district was set at 27 mills. How much tax would be paid by a man whose property is assessed at $4600.

5. A city fixes its tax rate at 17 mills for city purposes and 11.75 mills for schools. An owner of two houses, assessed at $5000 and $3500 paid how much in taxes altogether?

Approximating the Answer

Select the answer which is closest to the correct answer in each example. Then work each example to see if the selection which you have made is the right one.

1. .74 × 950 is closest to:	78, 780, 70, 700
2. $\frac{3045}{5946}$ is closest to:	$\frac{3}{8}$, $\frac{3}{4}$, $\frac{1}{2}$, $\frac{2}{3}$
3. 475 ÷ 1.48 is closest to:	30, 300, .03, 450
4. 128% of 960 is closest to:	1200, 1000, 1500, 2000
5. 7.35 × .085 is closest to:	6, .06, .006, .6
6. 360 is closest to ?% of 493:	75%, 140%, 90%, 50%



How Much Tax on Gasoline?

The graph shows the cost of gasoline in certain cities in Canada in a recent year.

1. In which city was the price of gasoline, not including the tax, the lowest? the highest? What was the cost of a gallon not including tax in each of these cities?

2. In which of the cities was the tax on a gallon of gasoline the most? the least? How much was the tax per gallon in each of these cities?

3. In which cities was the cost of a gallon of gasoline, including the tax, less than 40¢?

4. How much tax on gasoline did a person pay in a year in Regina if he drove his car 12,000 miles at an average of 20 miles per gallon?

5. Find the total cost of gasoline to operate a car:

   a. 9800 mi. at 19 miles per gallon in St. John's
   b. 15,000 mi. at 21 miles per gallon in Edmonton
   c. 7560 mi. at 18 miles per gallon in Regina
   d. 18,400 mi. at 16 miles per gallon in Vancouver.

★6. If you live in one of the cities shown, find out if the tax rate is the same on gasoline today as the rate given on the graph.

Provincial Tax Rates on Gasoline Are Not the Same

There is a tax on gasoline in every province in Canada. The tax per gallon is not the same in all provinces. The table shows the various rates and the number of provinces charging each rate in a recent year.

Rate	Number of Provinces
9¢	1
10¢	3
11¢	1
13¢	3
14¢	1
15¢	1

1. What is the lowest tax charged on a gallon of gasoline? the highest tax charged?

2. How many provinces charge the lowest tax? the highest tax?

3. What are the rates charged by the two largest numbers of provinces? How many provinces charged these taxes a gallon?

4. To the nearest tenth of a cent, find the average tax charged in this country. (Multiply each tax by the number of provinces using that rate. Find the sum of these products and divide by 10.)

5. At an average provincial tax of 12¢ on a gallon of gasoline, find the provincial tax a person would pay when he drives his car 9200 miles a year at an average of 16 miles to a gallon.

6. How many gallons of gasoline were consumed if the yearly tax at 4¢ a gallon was $26? $35? $45? $52?

★7. How much is the provincial tax on gasoline in your province?

★8. Does the federal government now impose a tax on gasoline?

★9. In what other ways does the provincial government obtain revenue from automobiles besides the tax on gasoline?

★10. What does your province do with the money it collects from the provincial tax on gasoline?

★11. Farmer Brown operates a tractor. Do you think he should pay provincial gas tax on the motor fuel used to operate the tractor?

★12. If a car averages 15 miles to a gallon what would be the total of all gasoline taxes paid for a 400 mile trip in your province?

How Well Do You Understand Our Number System?

1. In the number 2048, the value of the 2 is how many times the value of the 4? The value of the 2 is how many times the value of the 8?

2. In the number 2048, the value of the 8 is what fractional part of the value of the 2?

3. A digit in ten-thousandths' place is how many places to the right of ones' place?

4. Moving the decimal point three places to the right in a number is the same as multiplying by what number?

5. Each of the following four-place numbers is divisible by 9. What is the missing digit in 71?4? in ?368? in 9?44?

6. There is a carry-number of 5 from the sum of the figures in the ones' place of a column of two-place numbers. What is the least possible number of figures in this column?

7. In the example on the right, what is the regrouped value of each figure in 748 before the numbers may be subtracted?

$$\begin{array}{r} 748 \\ -156 \\ \hline \end{array}$$

8. Which of the following statements are true? Which are false? Give an illustration to prove each of your answers.

a. Both divisor and dividend may be multiplied by the same number without changing the value of the quotient.

b. Moving the decimal point one place to the left in the divisor and one place to the right in the dividend does not change the value of the quotient.

c. Moving the decimal point one place to the left of the number multiplied and one place to the right of the multiplier does not change the value of the product.

d. The number of decimal places in the dividend is equal to the number of decimal places in the divisor plus the number of decimal places in the quotient.

e. When the product of two numbers has as many decimal places as the number of decimal places in either of the two numbers multiplied, the other number is a whole number.

f. The product of an odd number and an even number is odd.

Practise What You Have Learned

1. $\begin{array}{r} \$\ 9.87 \\ 34.65 \\ 5.98 \\ 27.06 \\ 7.88 \\ \underline{16.49} \end{array}$

2. $\begin{array}{r} 31{,}025 \\ \underline{-11{,}096} \end{array}$

3. $\begin{array}{r} 708 \\ \underline{\times 507} \end{array}$

4. $\begin{array}{r} 14\frac{3}{4} \\ \underline{-8\frac{5}{8}} \end{array}$

5. $\begin{array}{r} 9\frac{1}{2} \\ 2\frac{7}{8} \\ 6\frac{3}{4} \\ \underline{1\frac{5}{8}} \end{array}$

6. $37\overline{)27456}$

7. $280\overline{)93451}$

8. $1\frac{1}{2} \times \frac{3}{8} =$

9. $2\frac{1}{4} \times 3\frac{1}{2} \times 3\frac{1}{3} =$

10. $\frac{4}{5} \div 1\frac{1}{2} =$

11. $7 \div 8 =$

12. $1.5\overline{)6}$

13. $6\overline{)75}$

14. $.04\overline{)3}$

15. $2\frac{1}{2}\%$ of 480 =

16. 35% of 360° =

17. 40 = ?% of 30

18. 50 = 4% of ?

19. 17 = ?% of 25

20. 160% of ? = 80

21. $\begin{array}{r} 4 \text{ ft. } 5 \text{ in.} \\ \underline{-1 \text{ ft. } 9 \text{ in.}} \end{array}$

22. $\begin{array}{r} 2 \text{ pt. } 10 \text{ fl.oz.} \\ \underline{\times 4} \end{array}$

23. $4\overline{)5 \text{ lb. } 8 \text{ oz.}}$

Number Quickies

1. What is the largest possible three-place even number?

2. How many watts are there in 2.5 kilowatts?

3. If one angle of a right triangle is 38°, how many degrees are there in the other acute angle of the triangle?

4. A cubic foot of water weighs 1000 ounces. If ice is 90% as heavy as water, what is the weight in ounces of a cubic foot of ice?

5. The U.S. gallon is equal to $\frac{4}{5}$ of the Canadian or Imperial gallon. If gasoline sells for 39.5¢ a gallon in Canada what is the equivalent price in the United States?

6. A cubic foot is equal to $\frac{4}{5}$ bushel. How many cubic feet are equal to a bushel?

7. A snail's tongue has 135 rows of teeth with 105 teeth in each row. How many teeth does a snail have on its tongue?

8. In a recent year, 250 million dollars in taxes were paid on motor vehicles. If 3 million vehicles were in operation, what was the average tax paid per vehicle?

INCOME TAX DATE

APRIL						
SUN	MON	TUE	WED	THU	FRI	SAT
				1	2	3
4	5	6	7	8	9	10
11	12	13	14	15	16	17
18	19	20	21	22	23	24
25	26	27	28	29	30	

Income Tax

Every person in this country whose income exceeds a certain amount must pay an **income tax** to the federal government. He is not required to pay a tax on a certain part of his income, which is called an **exemption**. A person's total or **gross income** less certain deductions and exemptions is his **net income** on which he pays taxes. The rate of income tax increases as the net income increases. Thus, the rate on a net income of $10,000 is much higher than the rate on a net income of $2000.

1. All income tax returns must be reported on or before the date shown above. What is this date?

2. A family of three has an income of $3200. If an exemption of $2000 is allowed for the parents and $300 for the child what is the net income on which taxes are paid?

3. At a rate of 17.5%, what is the amount of the income tax the family in problem **2** must pay?

The table below gives the amount of income tax in a recent year that a married man with a wife and one child would pay on different incomes before deducting other exemptions if he lived in Canada.

Income	Tax in Canada
$5000	$528.80
$10,000	$1854.20
$25,000	$8,875.00

4. The income tax is what per cent of the $5000 income? of the $10,000 income? of the $25,000 income?

★5. Have a member of your class go to the local post office and get a copy of Form T1 General for filing federal income taxes. Using the table on page 2 of this form, find the amount a single person has to pay if he has a net income of $1500; of $2400; of $3600.

More About Income Taxes

Between 25 and 30 per cent of all moneys received by the federal government come from taxes in individual incomes. The table shows in part, the rates of taxation in **taxable income.** Taxable income is that part of the income remaining after all allowable deductions have been made.

Taxable Income	Tax
$ 1,000 or less	18.5%
1,000	$ 185 plus 20.7% of next $1000
2,000	392 plus 23.4% of next 1000
3,000	626 plus 22.4% of next 1000
4,000	850 plus 25.7% of next 2000
6,000	1364 plus 30.6% of next 2000
8,000	1976 plus 35.5% of next 2000
10,000	2686 plus 41.0% of next 2000

(Note: This table includes a tax of 1%, to maximum of 30, for old age security.)

1. In a recent year the total amount collected by the federal government in taxes in personal income was $579,000,000. If the number of tax payers in the year was 2,400,000, what was the average tax paid by an individual tax payer?

2. John Brown earns $4000 a year. He rents his garage to a neighbor for $10 a month and he owns a $1000 Savings bond which pays $3\frac{3}{4}\%$ interest.

(a) What is Mr. Brown's total income?

(b) Since Mr. Brown is married and has no children, his exemption is $2000. What is his taxable income?

3. Mr. Green is married and has two children under 16 years of age. His exemption for himself and his wife is $2000, and for each child, $150. Compute his tax on a total income of $5750.

4. Using the rates given above, compute the income tax payable to the following persons.

Name	Total Exemptions	Total annual Income
Miss Abbey	$1000	$3750
Mr. Jones	5750	9500
Mr. Easton	4275	1,0000

Amusement Taxes

Several provinces in Canada obtain revenue for the provincial government by collecting a tax on tickets to movies, concerts, baseball games, the circus, and other amusements. In one province the rate of amusement taxes is as shown in the following table.

25 cents and under	no tax
over 25 cents and not over 28 cents	2 cents
over 28 cents and not over 32 cents	3 cents
over 32 cents and not over 36 cents	4 cents
over 36 cents and not over 40 cents	5 cents
over 40 cents and not over 44 cents	6 cents
over 44 cents and not over 48 cents	7 cents
over 48 cents and not over 52 cents	8 cents
over 52 cents and not over 56 cents	9 cents
over 56 cents and not over 60 cents	10 cents
over 60 cents and not over 64 cents	11 cents
over 64 cents and not over 68 cents	12 cents

Over 68 cents the tax is $17\frac{1}{2}\%$ calculated to the **next highest cent.** Example: Admission price without tax = 75 cents

Tax = $75¢ \times .175 = 13.125$ or 14 cents

1. What would be the tax on an admission price of 15 cents? of 30 cents? of 45 cents? of 60 cents?

2. Admission prices to a Celebrity Concert are \$1.75, \$2.50, \$3.75, and \$4.25, all plus tax. Find the amount of the amusement tax on each of these prices.

3. Prices for a baseball game were advertised as:

Grandstand	\$3.00 plus tax
Infield Bleachers	\$2.25 plus tax
Outfield Bleachers	\$1.50 plus tax

Find the total cost of each type of seat.

4. Many theatres advertise their admission prices as **tax included.** Find to the nearest cent the admission price without tax if the price of admission with tax included is 80 cents; \$1.20; \$2.35.

★5. Is there an amusement tax in your province? Does the provincial government use this tax for some special purpose? Find out what this purpose is.

What Canadian Tourists Buy Abroad

Customs' officers examine the baggage of tourists who return from abroad to see what they have bought. Tourists who go abroad are entitled to bring back to this country $100 worth of merchandise without paying **customs' duty**. There is a duty or tax collected by the federal government on the value of a tourist's merchandise which is in excess of $100. The table shows the value of some of the different kinds of articles the average tourist brings back to this country:

Kind of Article	Class of Passengers		
	First Class	Cabin	Tourist
a. Perfume	$34.00	$10.43	$3.04
b. Clothes, woolens, linen	97.55	60.09	8.65
c. Leather goods	29.01	20.14	9.73
d. Cameras and optical goods	8.43	28.71	11.15
e. China, cutlery	8.15	14.50	1.83
f. Jewelry	11.46	11.52	4.30
g. Miscellaneous	37.03	25.70	16.48
Total	?	?	?

1. What are the three different classifications of passengers on ships?

2. In how many of the items is the average amount spent by first class passengers less than the amount spent by cabin passengers?

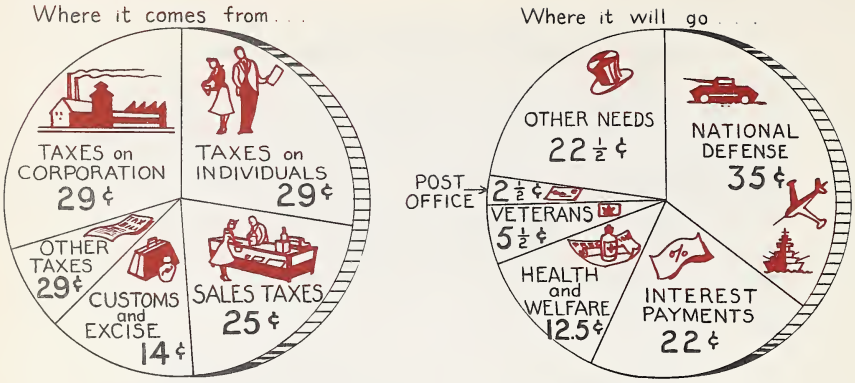
3. What is the total expenditure for each of the three groups?

4. What is the value of the merchandise a tourist is permitted to bring to this country free from duty?

5. To the nearest whole per cent, what per cent of $100 is the average value of goods brought into the country by first class passengers? by cabin passengers? by tourist passengers?

6. The average value of merchandise brought into this country by all classes of passengers is $132. To the nearest whole per cent, this amount is what per cent of $100?

★7. Find the meaning of **specific** duty; of **ad valorem** duty.



The Federal Government Dollar

The graphs show the sources from which the federal government received its income for a recent year and also the items for which the money was spent.

1. What was the greatest source of federal income?

2. For which item in our national government was the expenditure greatest?

3. What per cent of the income for the year shown was raised by custom and excise taxes?

4. The cost of wars is directly related to the cost of services for military, and veteran's needs. What per cent of the expenditures was spent for these three items?

5. According to the graph, when the amount of the yearly budget of our government is 4 billion dollars, how many billions of dollars would be raised by income tax on individuals? by income tax on corporations?

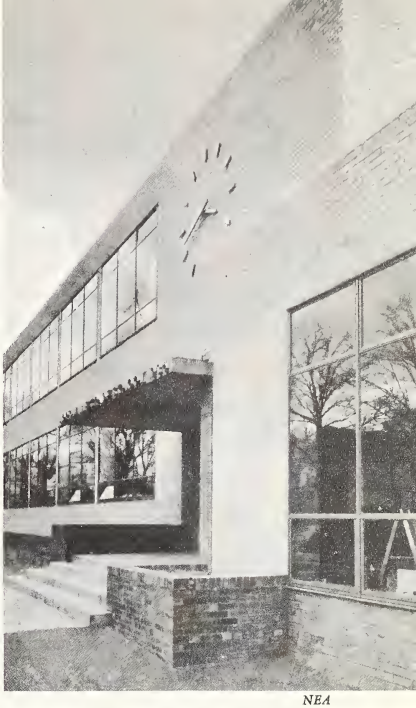
6. If our national revenue were 4 billion dollars, how many billions of dollars would go for military purposes?

7. If our population is 15 million and the expenditures of the federal government are 3.7 billion dollars, what is the average cost of government to each person in this country?

★8. How does the size of the yearly federal budget affect the cost of living? Why?

Public Debt

The picture shows a school building in Clearview. The money to pay for this school came from the sale of **bonds**. A bond is a promise to pay a certain sum, called the principal, which is known as the **face of the bond**. Bonds pay a fixed rate of interest, such as 3%, printed on the bond. The money to pay for the bonds of Clearview and the interest which they draw come from taxes. A certain amount of the money collected in taxes each year in Clearview is used to pay part of the principal and the interest on the bonds issued by the city. The total face value of the bonds which the city has issued is called the **city's debt** or the **bonded debt** of the city.



NEA

1. The cost of the school shown above was $500,000. If the face value of each bond was $1000, how many bonds were issued?

2. If each bond paid $2\frac{1}{2}\%$ interest, what was the yearly interest on a $1000 bond?

3. The federal government has a large gross national debt. At a recent date this debt was 17 billion dollars. What was the interest on this debt at an average rate of 3%?

4. From the graph on page 304, tell how much of each dollar spent by the federal government was used for payment of interest.

5. If our population is 15 million and our net national debt is 11 billion dollars, to the nearest $100, what is the average amount of the debt per person?

★6. How does the amount of the debt of a city affect the tax rate in the city? Why?

How Bonds Are Quoted

We learned that a city, a province, or the federal government may issue bonds. In the same way, many corporations issue bonds. Bonds may be purchased at banks and on stock exchanges. A fee or brokerage is charged for each bond sold on a stock exchange.

The **market value** of a bond as quoted in most daily newspapers is a per cent of the face value of the bond. Thus, a bond issued by a company which is quoted at 104 is selling at 104% of face value.

1. Find the market value of a \$1000 bond quoted at $102\frac{1}{2}$.

The market value is $102\frac{1}{2}\%$ of \$1000.

$$102\% \text{ of } \$1000 = 1.02 \times \$1000 = \$1020$$
$$1\% \text{ of } \$1000 = .01 \times \$1000 = \$10$$
$$\tfrac{1}{2}\% \text{ of } \$1000 = \tfrac{1}{2} \text{ of } \$10, \text{ or } \$5$$
$$\$1020 + \$5 = \$1025, \text{ the market value.}$$

2. Find the market value of \$1000 bonds quoted as follows:

a. 96 b. 104 c. $101\frac{1}{2}$ d. $98\frac{1}{4}$ e. $105\frac{3}{4}$

3. Find the yearly interest on a \$1000 bond quoted at 98 when the rate of interest is 4%.

Interest on a bond is always paid on the face value of a bond regardless of the market value of the bond.

$$4\% \text{ of } \$1000 = .04 \times \$1000 = \$40$$

The yearly interest is \$40.

4. Find the semi-annual interest on a \$1000-bond which is quoted as follows:

a. 98 at 3% c. $101\frac{1}{2}$ at 5% e. 107 at $3\frac{1}{2}\%$
b. 103 at 4% d. 96 at 4% f. 100 at $2\frac{1}{2}\%$

★5. In problem 4, each bond is for \$1000. Find the market value plus brokerage of each of these bonds if the brokerage fee is \$5 for each bond.

★6. If the semi-annual interest on a \$1000 bond is \$25, what rate of interest does the bond pay?

Getting Ready for the Progress Test in the Fundamentals

I. Add:

1. $\begin{array}{r} 96 \\ 708 \\ 3457 \\ 860 \\ 79 \\ \underline{2543} \end{array}$

2. $\begin{array}{r} \frac{1}{2} \\ \frac{1}{3} \\ \frac{3}{4} \\ \frac{7}{8} \\ \hline \end{array}$

3. $\begin{array}{r} 6\frac{1}{4} \\ 4\frac{5}{6} \\ 2\frac{2}{3} \\ \underline{7\frac{1}{2}} \end{array}$

4. $\begin{array}{r} 4.06 \\ 8.57 \\ 3.45 \\ \underline{7.56} \end{array}$

5. $\begin{array}{r} 4 \text{ lb. } 7 \text{ oz.} \\ 2 \text{ lb. } 9 \text{ oz.} \\ \underline{3 \text{ lb. } 15 \text{ oz.}} \end{array}$

6. $\begin{array}{r} 16 \text{ min. } 48 \text{ sec.} \\ \underline{9 \text{ min. } 35 \text{ sec.}} \end{array}$

II. Subtract

1. $\begin{array}{r} 4030 \\ \underline{2078} \end{array}$

2. $\begin{array}{r} 20{,}135 \\ \underline{19{,}456} \end{array}$

3. $\begin{array}{r} 7003 \\ \underline{28} \end{array}$

4. $\begin{array}{r} 5 \\ \underline{2\frac{7}{8}} \end{array}$

5. $\begin{array}{r} 13\frac{1}{4} \\ \underline{6\frac{5}{8}} \end{array}$

6. $\begin{array}{r} .475 \\ \underline{.250} \end{array}$

7. $\begin{array}{r} .055 \\ \underline{.046} \end{array}$

8. $\begin{array}{r} 4.125 \\ \underline{3.275} \end{array}$

9. $\begin{array}{r} 14 \text{ ft. } 6 \text{ in.} \\ \underline{9 \text{ ft. } 10 \text{ in.}} \end{array}$

III. Multiply:

1. $\begin{array}{r} 438 \\ \underline{6} \end{array}$

2. $\begin{array}{r} 580 \\ \underline{30} \end{array}$

3. $\begin{array}{r} 907 \\ \underline{308} \end{array}$

4. $\begin{array}{r} 75 \\ \underline{1.5} \end{array}$

5. $\begin{array}{r} 6.8 \\ \underline{.05} \end{array}$

6. $\frac{2}{3} \times 2\frac{1}{2} =$

7. $1\frac{1}{2} \times 3\frac{1}{4} \times \frac{2}{3} =$

8. $2\frac{3}{4} \times \frac{5}{6} =$

9. 102% of 420 =

10. $\frac{3}{4}$% of 1500 =

11. 3.4% of 880 =

12. $\begin{array}{r} 4 \text{ ft. } 8 \text{ in.} \\ \underline{3} \end{array}$

13. $\begin{array}{r} 16 \text{ min. } 27 \text{ sec.} \\ \underline{4} \end{array}$

14. $\begin{array}{r} 1 \text{ pt. } 8 \text{ fl.oz.} \\ \underline{5} \end{array}$

IV. Divide:

1. $6\overline{)5148}$

2. $27\overline{)8234}$

3. $360\overline{)94256}$

4. $1.5\overline{)1.26}$

5. $.04\overline{)38}$

6. $7.8\overline{)3.51}$

7. $\frac{7}{8} \div 2\frac{1}{2} =$

8. $72 \div 1\frac{1}{2} =$

9. $1 \div 2\frac{1}{2} =$

10. $\frac{5}{8}$ = ?%

11. 30 = ?% of 75

12. 10 = 2% of ?

13. 125% of ? = 50

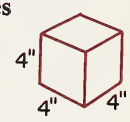
14. $4\overline{)15 \text{ ft. } 4 \text{ in.}}$

Vocabulary of Arithmetic

Define, illustrate, or use in a sentence each of the terms given below. The number in parentheses shows where the term is introduced.

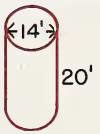
Assessed valuation	(293)	Income tax	(300)
Bond	(305)	Market value of a bond	(306)
Bonded debt	(305)	Mills	(295)
Duty (Customs)	(303)	Net income	(300)
Face of bond	(305)	Property tax	(294)
Gasoline tax	(296)	Tax exemption	(300)
Gross income	(300)	Tax rate	(293)

Finding Areas and Volumes



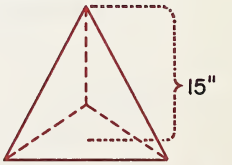
1. What is the formula for the area of a cube? What is the area of the cube having the dimensions given?

2. What is the formula for the volume of a cube? What is the volume of the cube having the dimensions given?



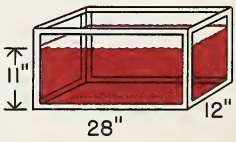
3. What is the formula for the lateral area of a cylinder? What is the lateral area of a cylinder having the dimensions given?

4. What is the formula for the volume of a cylinder ? What is the volume of a cylinder having the dimensions given?



5. The area of the base of the triangular pyramid at the right is 36 square inches. What is the volume of the pyramid?

6. The aquarium shown on the right is filled with water to a depth of 11 inches. Allowing 231 cubic inches to a gallon, how many gallons of water does it contain?



★**7.** If a cubic foot will hold .8 bushel, how many cubic feet does it take to hold a bushel?

Chapter Test

1. Which of the following organizations or services in a community are most likely to be supported by taxes? Which are most likely to be supported by private funds and subscriptions?

a. Churches
b. Courts
c. Fire Department
d. Police Department
e. Private Schools
f. Public Schools
g. Public Transportation
h. Red Cross
i. Scouts (Boy and Girl)

2. What is the difference between a property tax and an income tax?

3. A tax rate of 4.36% is equal to how many dollars on $100 of assessed valuation?

4. A city has an assessed valuation of 1 million dollars. If the amount to be raised by taxation is $45,000, what is the tax rate in mills?

5. Is the income tax on a net income of $5000 five times as much as the income tax on a net income of $1000? Why?

6. At a recent date, an unmarried person having a net income of $2500 paid $290 in income taxes. The tax was what per cent of the net income?

7. The income tax on a taxable income of $2500 is $392 plus 23.4% of the amount over $2000. Find the tax on an income of $2500.

8. The gross federal debt in a recent year was 17.5 billion dollars. This was an increase of half a billion dollars over the previous year. What was the per cent of increase?

9. Find the market value of a $1000 bond which sells at $103\frac{1}{2}$.

10. Find the semiannual interest on the bond in problem 9 if the rate of interest is $4\frac{1}{2}\%$.

11. A city has a bonded debt of 1.5 million dollars. If the average rate of interest on the bonds is 4%, how much money must be collected by the city to pay the yearly interest on the bonds?

12. At an average tax of 10.5¢ on a gallon of gasoline, find the total tax paid on gasoline consumed on 9600 miles of travel at an average of 20 miles to a gallon.

13. Give an illustration of a hidden tax.

Progress Test in the Fundamentals

Solve the following examples:

1. (48) .945 + .378 + .056 + .495

2. (8) 8031 − 56

3. (11) 780 × 80

4. (55) 7.4 × .35

5. (25) $9\frac{1}{4} - 5\frac{3}{8}$

6. (16) $37\overline{)21456}$

7. (16) $365\overline{)92830}$

8. (69) $1.6\overline{)5}$

9. (29) $\frac{7}{8} \times 5\frac{1}{3} =$

10. (29) $1\frac{1}{4} \times 4\frac{2}{5} \times 3\frac{1}{7} =$

11. (34) $4\frac{1}{2} \div \frac{7}{8} =$

12. (57) $2.5 \div 1000 =$

13. (34) $36 \div 4\frac{1}{2} =$

14. (67) $\frac{7}{8}$ to nearest 0.01 =

15. (92) 104% of 920 =

16. (102) $\frac{1}{2}$% of 1250 =

17. (98) 45 = ?% of 120

18. (98) 360 = ?% of 180

19. (108) 16 = 4% of ?

20. (108) 150% of ? = 90

If you did not understand how to work an example, turn to the page indicated in parentheses where the process is explained.

★For Those Who Made No Errors on the Above Test

We learned that both divisor and dividend may be multiplied by the same number without changing the value of the quotient. Thus, $3\overline{)15} = 5$ and $6\overline{)30} = 5$. We are able to use the principle that both divisor and dividend may be multiplied by the same number without changing the value of the quotient to enable us to divide a whole number by a fraction.

1. Find $\frac{2}{3}\overline{)8}$.

If we multiply any fraction by its denominator, the product will be the numerator. Hence, if we multiply $\frac{2}{3}$ by 3, the product is 2. If we multiply $\frac{2}{3}$ by 3, we must also multiply 8 by 3. Then,

$$3 \times \tfrac{2}{3}\overline{)3 \times 8} \quad = \quad 2\overline{)24}. \quad \text{The quotient is 12.}$$

2. Use the method shown above to divide the following.

a. $\frac{3}{4}\overline{)12}$ b. $\frac{4}{5}\overline{)36}$ c. $\frac{3}{7}\overline{)24}$ d. $\frac{4}{9}\overline{)10}$ e. $\frac{2}{5}\overline{)15}$

Test in Problem Solving

Solve the following problems. If you are unable to solve a problem, turn for help to the page indicated on the right.

1. A reservoir when full holds 4.5 billion gallons of water. When the reservoir is full, how many days' supply of water does it contain if the average daily consumption is 50 million gallons? (24)

2. A kilometer is equal to approximately $\frac{5}{8}$ mile. At that rate, what is the speed of an airplane in kilometers per hour when the speed of the airplane is 300 m.p.h.? (78)

3. How many thousandths are there in 3.7? (45)

4. When the price of a dozen eggs increased from 60¢ to 80¢, what was the per cent of increase in cost? (105)

5. A tank $\frac{5}{8}$ full contains 720 gallons. How many gallons will the tank hold when full? (37)

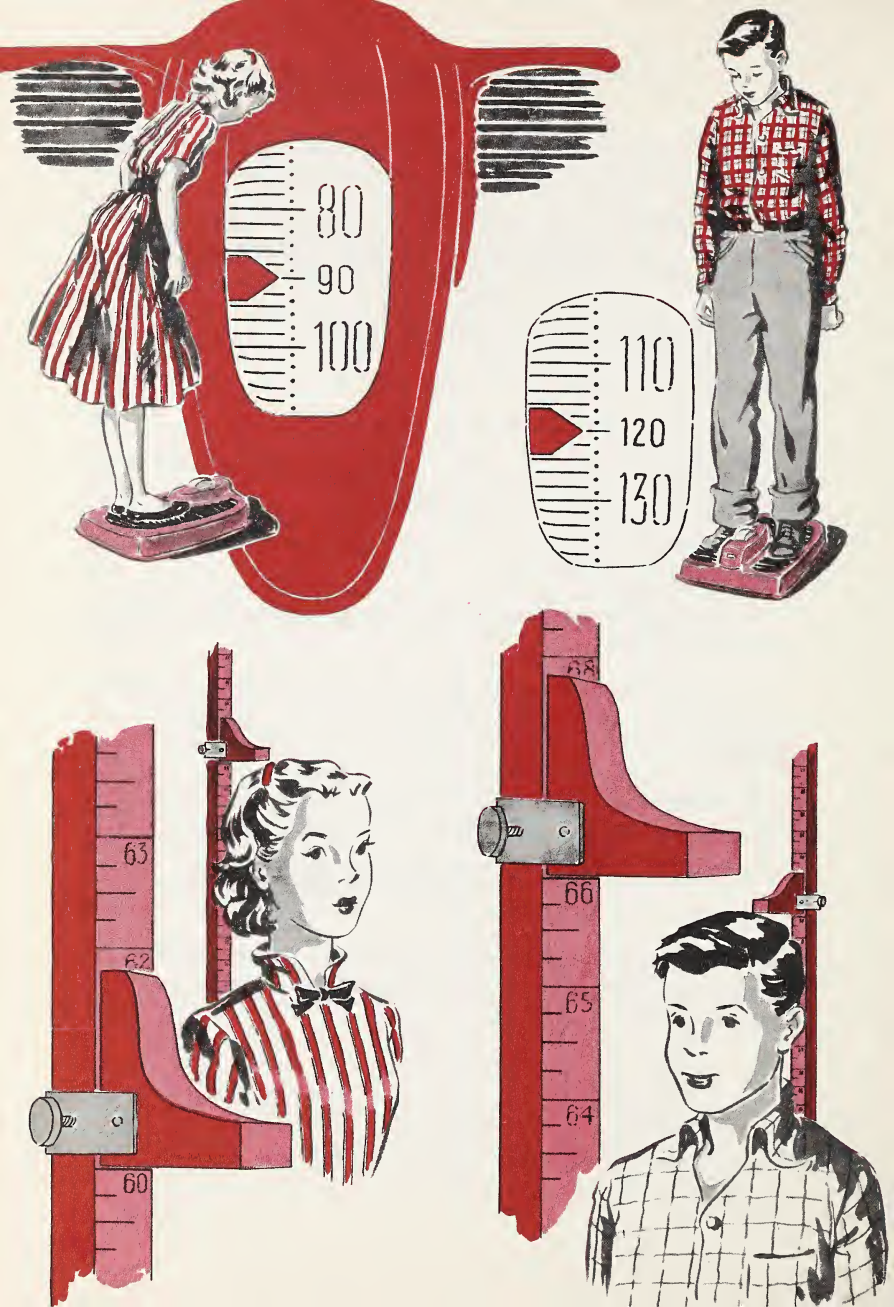
6. The semi-annual interest on a loan of $500 is $15. What is the rate of interest? (169)

7. One of the two perpendicular sides of a right triangle is 5 inches and the other side is 8 inches. What is the area of the triangle? (139)

8. A house is insured for $7500 against loss by fire. If the rate of insurance is 23¢ per $100, what is the yearly premium? (211)

9. How many cubic feet are there in a rectangular piece of ice 3 feet long, 2 feet wide, and 6 inches thick? (262)

10. At an average tax of 10.7¢ a gallon, find the tax paid on the gasoline consumed on a trip of 7500 miles at an average rate of 20 miles per gallon. (296)


80
90
100
110
120
130
63
62
60
66
65
64

Comparing Numbers

Thelma weighs 90 pounds and Tom weighs 120 pounds. Their weights may be compared either by **subtraction** or by **division**.

1. How much more does Tom weigh than Thelma? Did you compare their weights by subtraction or by division?

2. The weight of Thelma compared to the weight of Tom may be expressed as $\frac{90}{120}$. Express this fraction in lowest terms.

Here we compare the two weights by division. When we compare the weights by division, we are finding the **ratio** of the two numbers which represent the weights of the students.

The ratio of 3 to 4 may be written as follows:

a. $3 \div 4$ b. $\frac{3}{4}$ c. $3 : 4$

The ratio in c is read "3 to 4." Sometimes the other two ratios are read in the same way.

3. Thelma is 60 inches tall and Tom is 66 inches tall. How many times as tall as Thelma is Tom? Did you compare their heights by subtraction or by division?

4. What is the ratio of Thelma's height to Tom's height? Express the fraction in lowest terms.

5. What is the ratio of 5¢ to 10¢?

6. What is the ratio of 10¢ to 5¢?

7. What is the ratio of 5¢ to 3¢?

We see that the ratio of two numbers may be as follows:

a. In problem 5 the ratio is a **proper fraction**.

b. In problem 6 the ratio is a **whole number**.

c. In problem 7 the ratio is an **improper fraction** or a **mixed number**.

Find the ratio of:

8. 4 ft. to 8 ft.
9. 1 qt. to 1 pt.
10. 1 lb. to 5 lb.
11. 1 yd. to 2 ft.
12. 4 lb. to 1 lb.
13. 1 yd. to 18 in.

MORE PRACTICE 386

Ham or Cheese

The picture shows the ratio of the number of cheese sandwiches to the number of ham sandwiches sold on the average to passengers travelling on coaches of a large railroad system.

1. What is the ratio of the number of cheese sandwiches sold to the number of ham sandwiches sold?

2. What is the ratio of the number of ham sandwiches sold to the number of cheese sandwiches sold?

3. On the average, for every 4 sandwiches sold, how many are made of cheese? How many are made of ham?

4. The number of ham sandwiches sold is what part of the total number sold? What per cent of the total?

5. The number of cheese sandwiches sold is what part of the total number sold? What per cent of the total?

6. On the average, passengers on this railroad buy 8000 sandwiches daily. At the rates given, how many of these are made of cheese? How many are made of ham?

7. The passengers on the same railroad buy 8500 half-pint containers of milk daily. How many gallons of milk do the passengers buy each day?

8. If a sandwich sells at 25¢ and a carton of milk at 10¢, what is the ratio of the cost of a carton of milk to the cost of a sandwich? What is the ratio of the cost of a sandwich to the cost of a carton of milk?

9. A passenger in a coach had two sandwiches at 25¢ each and a carton of milk at 10¢ for his lunch. If he had eaten on the dining car, the cost of his lunch would have been $1.50. What is the ratio of the cost of his lunch served in a coach to the cost of a lunch served in the dining car? What is the ratio of the cost of a lunch served in a dining car to the cost of this lunch served in a coach?

10. The passengers of this railroad consume 3 million sandwiches in a year. It requires 120,000 long loaves of bread to make these sandwiches. On the average, one loaf will provide enough bread for how many sandwiches?

11. If three-fourths of all sandwiches sold on the railroad are made of ham, how many of the 3 million sandwiches sold are made of ham?

12. It requires 65,000 pounds of butter to make 3 million sandwiches. At that rate, one pound will provide butter enough for how many sandwiches? (Answer to the nearest whole number.)

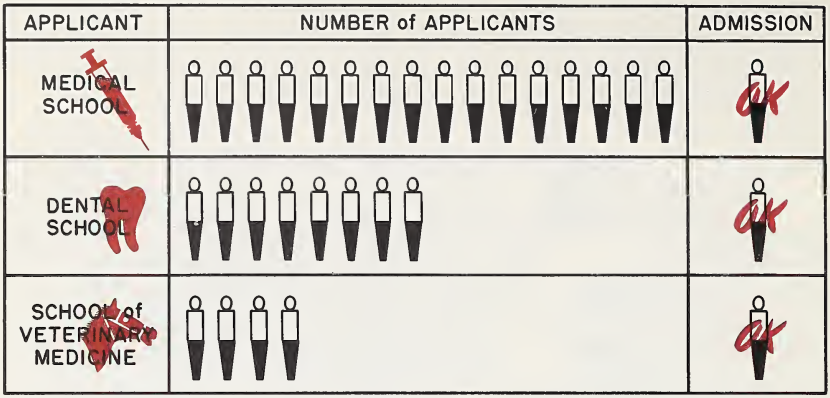
13. Find the ratio in each of the following:

a. A foot to a yard
b. A quart to a gallon
c. An ounce to a pound
d. An inch to a foot
e. A day to a week
f. A centimeter to a meter
g. A yard to a foot
h. A quart to a pint
i. An hour to a minute
j. A dime to a quarter dollar
k. A bushel to a peck
l. A gram to a kilogram

14. What is the ratio of a foot to a foot?

★15. If the ratio between two numbers is 1, what may be said about the size of the numbers?

★16. What is the ratio of the circumference of a circle to the diameter?



Many Applicants—Few Admissions

The graph shows the number of students who applied in a recent year for admission to schools of medicine, dentistry, and veterinary medicine, to each student admitted to these schools.

1. One student was admitted from a group of how many who applied for admission to schools of medicine? to schools of dentistry? to schools of veterinary medicine?

2. What per cent of the applicants were admitted to schools of medicine? to schools of dentistry? to schools of veterinary medicine?

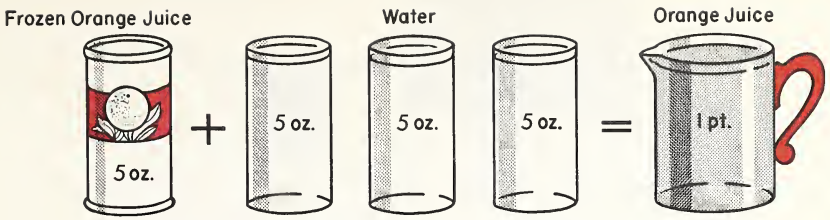
3. In a recent year the number of applicants for admission to medical schools in this country was 8800. At the rate shown on the graph, how many of the applicants were accepted?

4. In a recent year the number of applicants for admission to dental schools was 2144. At the rate shown above, how many of the applicants were accepted?

5. If the number of applicants for admission to schools of veterinary medicine was 324, at the rate given above, how many of the applicants were accepted?

6. Find the ratio of the number accepted to the number of applicants in each of the following:

a. 4820 applicants; 964 admissions; b. 7350 applicants; 1225 admissions; c. 93,940 applicants; 8540 admissions.



Frozen Orange Juice to Liquid Orange Juice

1. In the picture above, how many ounces are there of frozen orange juice? how many ounces of water?

2. What is the ratio of the number of ounces of frozen juice to the number of ounces of water?

3. How many ounces are there if the 4 cans are mixed?

4. Pure orange juice is what part of the mixture? Pure orange juice is what per cent of the mixture?

5. Water is what part of the mixture? Water is what per cent of the mixture?

6. A bowl contains 60 fluid ounces of liquid made from frozen orange juice and water. At the ratio shown above, how many ounces of frozen orange juice were used to make the mixture?

Think: "The frozen orange juice is $\frac{1}{4}$ of the mixture; hence the orange juice is $\frac{1}{4}$ of 60 oz."

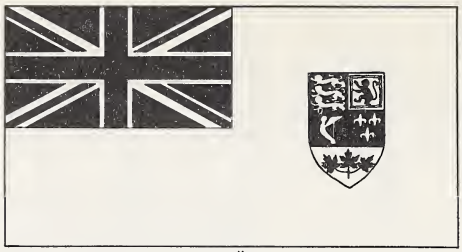
7. If the ratio of the number of boys to the number of girls is 3 : 4, the number of boys is what part of the total? The number of girls is what part of the total?

8. In problem 7, find the number of boys and the number of girls in a group of 35 students; of 140 students; of 560 students.

9. A board 16 feet long is cut into two pieces which are in the ratio of 3 : 5. The shorter piece is what part of the whole piece? What is the length of each piece?

★10. Two numbers are in the ratio of 2 : 3. Find each number when the sum of the numbers is: a. 25; b. 40; c. 55; d. 120; e. 375; f. 1000.

★11. Using the ratio in problem 10, what is the smaller number when the larger number is 15? 45? 120?



Applications of Ratios

1. The ratio of the width of a rectangle to the length is 4 : 5. What is the ratio of the length to the width?

2. In problem 1, if the width of a rectangle is 12 feet, what is the length? If the length of a rectangle is 10 feet, what is the width?

3. What is the width of the flag represented? What is the length? What is the ratio of the length to the width of the flag?

4. If the flag shown above is 30 inches wide, what should be its length? If the flag is 76 inches long, what should be its width?

5. What is the ratio of the length to the width of a rug which is $9' \times 12'$?

6. A recipe for making jam calls for 3 pounds of sugar to 4 pounds of berries. How many pounds of sugar are needed for 8 pounds of berries?

7. In problem 6, how many pounds of sugar are needed to make 14 pounds of jam? How many pounds of berries are needed for 14 pounds of jam?

8. How many degrees are there in the sum of the two acute angles of a right triangle?

9. The two acute angles of a right triangle are in the ratio of 1 : 2. The smaller angle is what fractional part of the larger acute angle? How many degrees are there in each angle?

★ 10. When the ratio between any two sides of a triangle is 1, what kind of triangle is it?

★ 11. The ratio of the number of ounces of fruit juice to the number of ounces of water in a soft drink is 1 : 4. How many fluid ounces of fruit juice and of water are needed to make a gallon of the drink?

Practise What You Have Learned

1. $\begin{array}{r} 746 \\ 3079 \\ 208 \\ 1653 \\ 87 \\ 495 \\ \hline \end{array}$

2. $\begin{array}{r} 10{,}023 \\ -\,49 \\ \hline \end{array}$

3. $\begin{array}{r} 376 \\ \times 208 \\ \hline \end{array}$

4. $\begin{array}{r} .725 \\ -.457 \\ \hline \end{array}$

5. $\begin{array}{r} 2\frac{1}{4} \\ 3\frac{1}{2} \\ 5\frac{7}{8} \\ 2\frac{5}{8} \\ \hline \end{array}$

6. $38\overline{)21456}$

7. $246\overline{)14954}$

8. $.04\overline{)3}$

9. $1.2\overline{).168}$

10. $\overline{4).01}$

11. $\frac{5}{8}$ to nearest 0.1 =

12. $\frac{3}{4} \times 2\frac{2}{3} =$

13. $2\frac{1}{2} \times 1\frac{1}{4} \times \frac{5}{6} =$

14. $4\frac{1}{2} \div \frac{5}{8} =$

15. $6 \div 2\frac{1}{2} =$

16. $\frac{1}{4}\%$ of 1280 =

17. 3.4% of 270 =

18. 50 = ?% of 75

19. 60 = 5% of ?

20. 110% of ? = 550

Number Quickies

1. When lemons sell at the rate of 3 for 10¢, what is the cost of a dozen lemons?

2. A 2-lb. box of candy costs $1.50. At that rate, what should be the cost of a 5-lb. box of the same kind of candy?

3. A steel rod 4 ft. long weighs 19 pounds. What should be the weight of a steel rod of the same diameter which is 12 ft. long?

4. A car travels 5 mi. in 8 minutes. At that rate, how far will it travel in an hour?

5. A car has a speed of 50 m.p.h. At that rate, how far will it travel in 20 min.?

6. An airplane is moving at a speed of 200 m.p.h. At that rate, how far will it travel in 36 minutes?

7. An airplane travels 120 mi. in 25 minutes. At that rate, how far will it travel in an hour?

8. The cost to fill a tank $\frac{3}{4}$ full with fuel oil is $120. At that rate, what will it cost to fill the tank with fuel oil?

9. A board 15 ft. long is cut into two pieces. If the ratio of the lengths of the two pieces is 2 : 3, what is the length of each piece?

10. A cubic foot of water weighs 62.5 lb. What is the weight of $2\frac{1}{2}$ cubic feet of water?

Direct and Indirect Measurement

The picture on the left shows Art measuring the height of a door. He used **direct measurement** to find the height.

The picture on the right shows Sam finding the height of the flagpole. He is unable to climb to the top of the pole, so he measures the length of the shadow which the pole casts. Then he is able to find the height of the flagpole by **indirect measurement.**

1. A pole known to be 5 feet tall casts a shadow 4 feet long. What is the height of a flagpole which casts, at the same time, a shadow 36 feet long?

The ratio of the height of the 5-foot pole to the length of its shadow is 5 : 4, or $\frac{5}{4}$, or $1\frac{1}{4}$. Likewise, the height of the flagpole must be $1\frac{1}{4}$ times the length of its shadow.

$$\frac{5}{4} \times 36 = 45$$

The height of the flagpole is 45 feet.

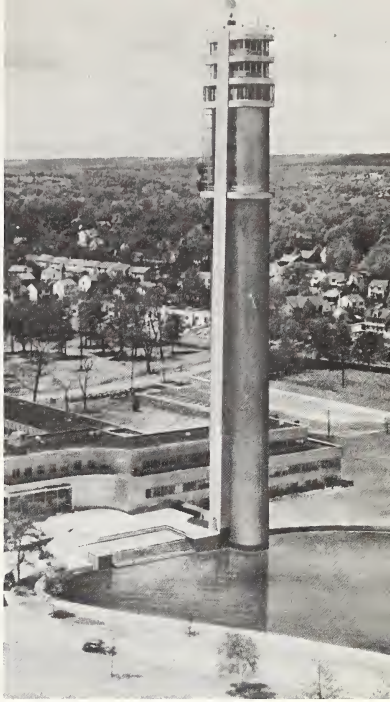
2. If a stick 6 feet high casts a shadow 6 feet long, what is the ratio of the height of the stick to the length of its shadow?

3. When the ratio of the height of a tree to the length of its shadow is 1, find the height of a tree which casts a shadow 38 feet long; a shadow 55 feet long.

4. A man 6 feet tall casts a shadow 5 feet long. Find the height of a tree which, at the same time, casts a shadow 30 ft. long; 40 ft. long; 60 ft. long.

★**5.** A yardstick standing in a vertical position casts a shadow $4\frac{1}{2}$ feet long. What is the height of a tower which, at the same time, casts a shadow 120 feet long?

Finding Heights of Objects



1. A pole 15 feet high casts a shadow 5 feet long. What is the ratio of the height of the pole to the height of the shadow?

2. Use the ratio given in problem **1.** What is the height of the tower on the right when the length of the tower's shadow is 100 feet?

3. If the length of the tower's shadow were only 50 feet, what would be the height of the tower? (Ratio from problem **1.**)

4. Is the shadow of an object, such as the tower, longer in the morning and evening, or at noon? Why?

5. A boy 5 feet tall casts a shadow 8 feet long. What is the height of a tree which, at the same time, casts a shadow 40 feet long?

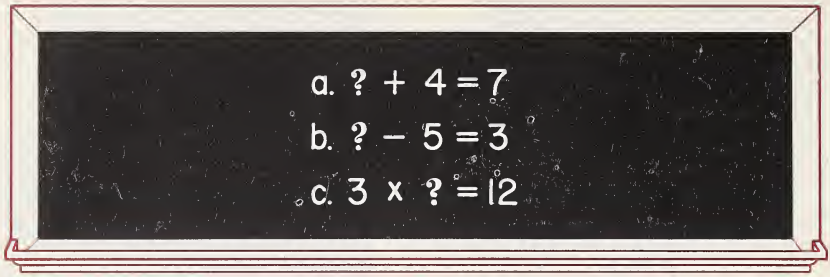
6. Jimmy worked problem **5** by finding $\frac{5}{8}$ of 40 feet. Show why the answer he got is sensible.

7. A tower casts a shadow 75 feet long. At the same time, a pole 10 feet high casts a shadow 12 feet long. What is the height of the tower?

8. A telephone pole casts a shadow 30 feet long at the same time a stick 5 feet high casts a shadow 6 feet long. What is the height of the pole?

9. After Martha solved problem **8**, she said, "I am not sure whether the number of feet in the height is found by multiplying 30 by $\frac{5}{6}$ or by $\frac{6}{5}$." What is $\frac{5}{6} \times 30$? What is $\frac{6}{5} \times 30$? How can you tell which answer is sensible and which answer is not sensible? (Is the shadow longer or shorter than the height?)

★**10.** In problem **8**, find the height of the pole when the length of the shadow of the stick is $7\frac{1}{2}$ feet.



The Equation

The question mark in each of the examples above is read, "What number?" We may read the first example, "What number added to 4 equals 7?" What is the number?

Instead of a question mark, we may use a letter, such as **n**, to indicate the missing number. In formulas we often use the first letter of a word to represent the word. In the formula for the area of a rectangle, we use ***l***, the first letter of the word length, to represent length. In the same manner, we use **w** to represent width. If we replace ? with **n**, the first example above becomes $\mathbf{n} + 4 = 7$. We know that $\mathbf{n} = 3$ because $3 + 4 = 7$.

The example $\mathbf{n} + 4 = 7$ is an **equation**.

An equation has two parts that are equal. At least one of the numbers in an equation is represented by a letter.

The two parts of the equation $\mathbf{n} + 4 = 7$ are $\mathbf{n} + 4$ and 7. The value of $\mathbf{n} + 4$ is equal to 7.

1. If **n** is the missing number in **b** above, what is the equation? What is the value of **n**?

2. If **n** is the missing number in **c** above, what is the equation? What is the value of **n**?

Find the missing numbers (**n**) in each of the following:

	a	b	c
3.	$\mathbf{n} + 1 = 4$	$2 + \mathbf{n} = 5$	$3 + \mathbf{n} = 12$
4.	$\mathbf{n} - 2 = 7$	$2 \times \mathbf{n} = 8$	$12 \div \mathbf{n} = 4$
5.	$4 \times \mathbf{n} = 20$	$15 \div \mathbf{n} = 3$	$8 + \mathbf{n} = 10$
6.	$5 + \mathbf{n} = 8$	$16 \div \mathbf{n} = 2$	$20 \div \mathbf{n} = 2$
7.	$9 \div \mathbf{n} = 12$	$\mathbf{n} - 8 = 3$	$\mathbf{n} \times 3 = 12$

The Members of an Equation

H. Armstrong Roberts

We may compare an equation to a pair of balance scales. If the scales are in balance, the weight of the object in the pan on on the left must be equal to the weight of the object in the pan on the right.

An equation has two **members,** one on each side of the sign of equality. In the equation $n - 3 = 2$, one member of the equation is $n - 3$ and the other member is 2. We may use a letter to represent a number, such as **a**, **m**, **x**, or any other letter.

1. What are the members of each of the following equations?

a. $n + 2 = 5$ b. $x - 4 = 6$ c. $\frac{1}{2}a = 3$ d. $3w = 6$

The scales shown above are in balance. If we make a change in the weight of the object in one of the pans, we must make an equal change in the weight of the object in the other pan to keep the scales in balance. Likewise, we must make changes in each member of an equation to keep the equation true.

Whenever we change one member of an equation, we must make the same change in the other member of the equation.

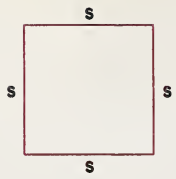
2. If we add 5 to one member of an equation, what number must be added to the other member of the equation?

3. If we add 3 to one member of an equation and subtract 3 from the other member of the equation, is the value of the equation affected? Why?

4. If we multiply one member of an equation by 2, what change must be made in the other member of the equation?

5. Both members of an equation are divided by 3. How does that affect the value of the equation?

6. If 10 is added to both members of an equation, is the value of the equation changed?



The Division Rule of Equations

1. The perimeter of a square is 20 inches. What is the length of a side of the square?

The sum of the sides is $4s$ and the perimeter is 20; hence, the equation is $4s = 20$. Why does $4s$ represent the perimeter?

The equation: $4s = 20$

Divide both members by 4: $\frac{4s}{4} = \frac{20}{4}$

This gives: $s = 5$

The side of the square is 5 in.

Check: Substitute 5 for s in the equation $4s = 20$. Then the equation becomes $4 \times 5 = 20$. Since 4×5 is equal to 20, the value 5 for s is correct.

The equation $4s = 20$ was solved by use of the division rule of equations. This rule is as follows: **Both members of an equation may be divided by the same number without changing the value of the equation.** In problem 1, why did we divide by 4?

Solve and check each of the following equations:

	a	b	c	d
2.	$3n = 18$	$6x = 12$	$5y = 40$	$7a = 35$
3.	$5x = 60$	$8n = 72$	$4a = 76$	$9c = 54$
4.	$60 = 4p$	$75 = 15x$	$36 = 12h$	$26 = 4p$
5.	$9 = 2h$	$52 = 8x$	$3x = 1.2$	$8n = 9.6$
6.	$4c = 5.2$	$9y = 1.08$	$2n = 3.5$	$5x = 1.2$
7.	$9x = 8.1$	$14c = .42$	$28n = 14$	$36z = 24$

8. If 4 dozen oranges cost \$1.44, what is the cost per dozen? If x represents the cost of one dozen, what will $4x$ represent? To what number is $4x$ equal?

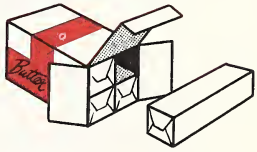
★9. The area of one triangle is 5 times the area of another triangle. If the area of the larger triangle is 120 square feet, what is the area of the smaller triangle?

MORE PRACTICE

The Multiplication Rule of Equations

1. A quarter pound of butter costs 23¢. At that rate, what is the cost of a pound of butter?

If **p** represents the cost of a pound of butter, then $\frac{1}{4}\mathbf{p}$ will be the cost of a quarter pound of butter or 23¢.



The equation is $\frac{\mathbf{p}}{4} = 23$.

$\frac{1}{4}\mathbf{p}$ and $\frac{\mathbf{p}}{4}$ have the same value.

The equation: $\frac{\mathbf{p}}{4} = 23$

Multiply both members by 4: $4 \times \frac{1}{4}\mathbf{p} = 4 \times 23$

The product of: $4 \times \frac{1}{4}\mathbf{p} = 1\mathbf{p}$ or $\mathbf{p}$

Then, $\mathbf{p} = 4 \times 23$ or 92

The cost of one pound of butter is 92¢.

Check: Substitute 92 for **p** in the equation, $\frac{\mathbf{p}}{4} = 23$.

Then, $\frac{92}{4} = 23$.

The equation $\frac{\mathbf{p}}{4} = 23$ was solved by the use of the multiplication rule of equations. This rule is as follows: **Both members of an equation may be multiplied by the same number without changing the value of the equation.** In problem 1, we multiplied by 4 to change $\frac{1}{4}$ to one whole.

Solve and check each of the following equations:

	a	b	c	d
2.	$\frac{\mathbf{x}}{3} = 5$	$\frac{\mathbf{n}}{4} = 7$	$\frac{\mathbf{a}}{2} = 5$	$\frac{\mathbf{n}}{5} = 6$
3.	$12 = \frac{\mathbf{n}}{4}$	$25 = \frac{\mathbf{a}}{6}$	$32 = \frac{\mathbf{y}}{4}$	$\frac{\mathbf{z}}{12} = 14$
4.	$\frac{\mathbf{x}}{3} = 1.6$	$\frac{\mathbf{n}}{4} = 5.8$	$\frac{\mathbf{a}}{5} = 3.5$	$\frac{\mathbf{x}}{2} = 2\frac{1}{2}$

5. A quarter yard of ribbon costs 45¢. At that rate, what is the cost of a yard of ribbon? If **x** represents the cost of a yard, then $\frac{\mathbf{x}}{4}$ represents the cost of a quarter yard, or what number?

MORE PRACTICE

ORIGINAL AMOUNT

AMOUNT HE HAS NOW

The Addition Rule of Equations

1. Jack spent 10¢ and then had 25¢ left. How much did he have at first?

If **x** represents the amount of money he had at first, then $x - 10$ is the amount remaining after he spent 10¢, or $x - 10 = 25$.

The equation: $x - 10 = 25$

Add 10 to both members: $\underline{\quad 10 = 10}$

$x \quad = 35$

Jack had 35¢.

Check: Substitute 35 for **x** in the equation, $x - 10 = 25$.

$$35 - 10 = 25$$

The equation $x - 10 = 25$ was solved by the use of the addition rule of equations. This rule is as follows: **The same number may be added to both members of an equation without changing the value of the equation.** Why do we add 10 in problem 1?

Solve and check each of the following equations:

a	b	c
2. $n - 5 = 8$	$x - 4 = 11$	$r - 7 = 24$
3. $y - 12 = 16$	$n - 8 = 25$	$a - 15 = 46$
4. $10 = x - 8$	$27 = x - 18$	$44 = a - 17$
5. $x - \frac{1}{4} = \frac{1}{2}$	$x - \frac{3}{4} = 1$	$x - 1.4 = 5.2$
6. $n - .9 = 1.5$	$a - 2\frac{1}{2} = 1\frac{1}{4}$	$n - 4.5 = 3.8$

7. The width of a rectangle is 4 inches less than the length. If the width is 6 inches, what is the length? If **x** represents the length, why does $x - 4$ represent the width? What number has the same value as $x - 4$?

★8. A class has 3 fewer girls than boys. If there are 14 girls in the class, how many boys are there?

MORE PRACTICE

387

The Subtraction Rule of Equations

1. The number of boys in a group is 3 more than the number of girls. If there are 7 boys, how many girls are there?

If x represents the number of girls, then $x + 3$ represents the number of boys, or 7. The equation is $x + 3 = 7$.

The equation gives: $x + 3 = 7$

Subtracting 3 from each member of the equation: $3 = 3$

$x = 4$, number of girls

Check: Substitute 4 for x in the equation, $x + 3 = 7$.

$$4 + 3 = 7.$$

The equation $x + 3 = 7$ was solved by the use of the subtraction rule of equations. This rule is as follows: **The same number may be subtracted from both members of an equation without changing the value of the equation.** Why did we subtract 3 in problem 1?

Solve and check each of the following equations:

a	b	c
2. $x + 5 = 8$	$n + 7 = 9$	$y + 4 = 12$
3. $a + 6 = 15$	$p + 11 = 20$	$r + 15 = 32$
4. $27 = 12 + x$	$41 = 15 + a$	$72 = 45 + y$
5. $x + \frac{1}{2} = \frac{3}{4}$	$n + 1.5 = 7.6$	$h + 2.8 = 5.4$
6. $a + 1\frac{1}{2} = 2\frac{1}{4}$	$c + \frac{1}{8} = \frac{1}{2}$	$h + 4.7 = 6.5$

7. The length of a rectangle is 3 inches more than the width. If the length is 12 inches, what is the width? If x represents the width, then $x + 3$ represents the length. Why? What number has the same value as $x + 3$?

★8. Dick has 37¢ more money than Tony has. If Dick has 75¢, how much money does Tony have?

MORE PRACTICE

Using Two Rules to Solve Equations

Sometimes it is necessary to use more than one rule to solve an equation.

The samples show how to apply two rules to solve an equation.

1. If $\frac{3}{4}$ of a number is 72, what is the number?

If n represents the number, then $\frac{3}{4}n$ represents $\frac{3}{4}$ of the number. $\frac{3}{4}n$ and $\frac{3n}{4}$ have the same value. The equation is $\frac{3n}{4} = 72$.

The equation: $\frac{3n}{4} = 72$

Multiply both members by 4: $4 \times \frac{3n}{4} = 4 \times 72$

This gives: $3n = 288$

Then divide both members by 3: $n = 96$, the number

Check: $\frac{3}{4} \times 96 = 72$, substituting 96 for n in $\frac{3n}{4} = 72$
or $72 = 72$

2. Solve the equation $2x - 3 = 35$.

The equation: $2x - 3 = 35$

Add 3 to both members: $\underline{\quad\quad + 3 = \quad 3}$

This gives: $2x \quad\quad = 38$

Then divide both members by 2: $x \quad\quad = 19$

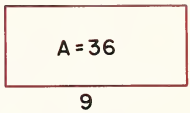
Check: Substituting 19 for x in $2x - 3 = 35$
$2 \times 19 - 3 = 35$, or $38 - 3 = 35$

Solve and check each of the following equations:

	a	b	c
3.	$\frac{2n}{3} = 12$	$4a - 5 = 23$	$\frac{h}{3} - 2 = 6$
4.	$3x + 1 = 40$	$5n - 8 = 52$	$3h + 7 = 31$
5.	$\frac{a}{5} + 3 = 7$	$\frac{3x}{5} = 45$	$20 = \frac{5a}{6}$
6.	$4x - 3 = 37$	$6x - 7 = 20$	$4y + 3 = 17$
7.	$45 = \frac{9x}{10}$	$2n + 5 = 27$	$\frac{x}{4} - 1 = 0$
8.	$\frac{b}{2} - 3 = 9$	$\frac{a}{2} + 3 = 8$	$35 = \frac{7y}{8}$

Finding Missing Dimensions of Figures

1. What is the formula for the area of a rectangle? If we substitute the numbers given on the right in the formula $A = lw$, the equation formed is $9w = 36$. Solve for w.



2. Use the formula for the area of a rectangle.

   a. Find l when $A = 60$ sq. in. and $w = 6$ in.

   b. Find w when $A = 75$ sq. ft. and $l = 15$ ft.

3. Use the formula for the area of a parallelogram.

   a. Find b when $A = 96$ sq. ft. and $h = 6$ ft.

   b. Find h when $A = 72$ sq. cm. and $b = 18$ cm.

4. Use the formula for the area of a triangle and find h when the area is 72 square feet and the base is 9 feet.

The formula: $A = \frac{1}{2}bh$

Substitute numbers given: $72 = \frac{1}{2} \times 9 \times h$

or $72 = \frac{9h}{2}$

Multiply both members by 2: $144 = 9h$

Divide both members by 9: $16 = h$

Check: Substituting 16 for h in the equation, $72 = \frac{9h}{2}$

$$72 = \frac{16 \times 9}{2}, \text{ or } 72 = 72$$

5. Use the formula for the area of a triangle.

   a. Find b when $A = 156$ sq. ft. and $h = 13$ ft.

   b. Find h when $A = 48$ sq. in. and $b = 12$ in.

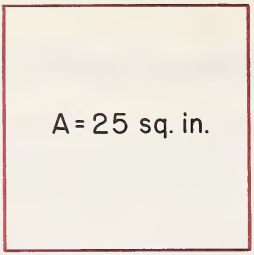
★6. Use the formula $V = lwh$.

   a. Find l when $V = 480$, $w = 8$, and $h = 5$.

   b. Find w when $V = 252$, $l = 9$, and $h = 4$.

   c. Find h when $V = 24$, $l = 16$, and $w = 3$.

★7. Use the formula $V = \frac{1}{3}Bh$, and find B when $V = 96$ and $h = 4$; h when $V = 150$ and $B = 15$.



Finding the Side of a Square

If the area of a square is given, it is possible to find a side by solving the equation formed by substituting the number which represents the area in the formula $A = s^2$. The area of the square shown above is 25 square inches. If we substitute this number in the formula, the equation formed is $25 = s^2$, or $s^2 = 25$. To find **s** in this equation, we take the **square root** of each member of the equation. Then $s = 5$. A side is 5 inches.

The square root of a number is the number which when multiplied by itself gives a product equal to the given number.

The symbol for square root is $\sqrt{\ }$. Thus, the $\sqrt{25}$ is 5 because $5 \times 5 = 25$.

1. $8 \times 8 = 64$; therefore 8 is the square root of 64. What is the square root of 100? of 36? of 81? of 49?

2. A square has an area of 64 square inches. What is the length of a side of the square?

3. How many square inches are there in a square foot?

4. A square has an area of 144 square inches. How many inches are there on a side of the square?

5. A square has an area of 1 square mile. What is the length in miles of each side of the square?

6. Make a list of the squares of the numbers from 10 to 20. From your list, what is $\sqrt{169}$? What is $\sqrt{225}$? What is $\sqrt{324}$? What is $\sqrt{196}$?

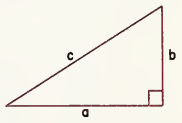
7. Such numbers as 4, 9, and 25 are called **perfect squares** because the square root of each of these numbers can be found. Which of the following numbers are perfect squares? 1, 2, 16, 20, 36, 45, 55, 81, 100.

The Right Triangle

Ted and his father inquired of an attendant at a gas station, "How far is it to the Old Mill?"

"It is 7 miles if you go east 4 miles to Four Corners and then go north 3 miles. It is only 5 miles as the crow flies."

The information which the attendant at the gas station gave makes use of a principle of a right triangle. The two sides of a right triangle which are perpendicular to each other are called the **arms** or **legs** of the triangle. The side opposite the right angle is called the **hypotenuse.**



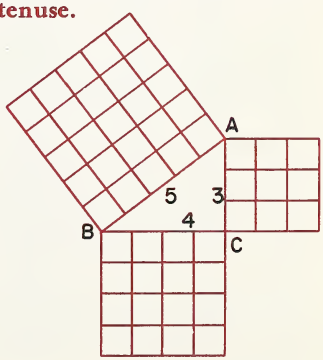
1. In the triangle on the right, which two sides are arms? Which side is the hypotenuse?

2. In the figure shown below, a square is drawn on each side of the right triangle ABC. How many small squares are there on the side BC? How many squares on the side AC?

3. How many small squares are there in the sum of the two squares on the sides AC and BC?

4. How many small squares are there in the square on the hypotenuse, or AB? Is the number the same as the number you found in problem 3?

In any right triangle, the sum of the squares on the two arms is equal to the square on the hypotenuse.



5. Prove that $3^2 + 4^2 = 5^2$. A triangle having sides in the ratio of 3, 4, and 5 is called a 3-4-5 triangle. A triangle of this kind is always a right triangle.

6. Draw a 3-4-5 triangle and prove that the information which the attendant at the gas station gave to Ted and his father was correct.

Finding the Square Root of a Number

Some of the numbers in the table on the right are missing. The numbers in the column headed by N are the square roots of the numbers in the column headed by N^2.

N	N^2	N	N^2
1	1	10	100
2	4	20	400
3	9	30	900
4	16	40	1600
?	?	?	?
?	?	?	?
?	?	?	?
?	?	?	?
9	81	90	8100

1. Copy the table and supply the missing numbers.

2. From the table, the square root of a one-or-two-place whole number contains how many places?

3. The square root of a three-or-four-place whole number contains how many places?

The table on page 333 shows the square and the square root of every whole number from 1 to 150. The roots of numbers not perfect squares can only be approximated. In the table these roots are given to the nearest hundredth. Use the table to answer the following:

4. Find the square of 13; of 29; of 67; of 87; of 138.

5. Find the square root of 2; of 55; of 128; of 137.

6. Find the square root of 1849.

Find 1849 in the column headed by N^2. The square root of 1849 is opposite this number in the column headed by N. What is the square root of 1849? How much is 43×43?

7. Find the square root of 676; of 2304; of 7744; of 18,769.

8. Find the approximate square root of 925.

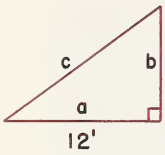
The number 925 is not given in the table. This number is between 900 and 961. The square root of 900 is 30 and the square root of 961 is 31; therefore the square root of 925 is between 30 and 31. Since 925 is nearer to 900 than to 961, the square root of 925, to the nearest whole number, is 30.

9. To the nearest whole number, find the square root of 500; of 1200; of 6100; of 17,450; of 375; of 1582; of 10,425.

Table of Squares and Square Roots

N	N^2	$\sqrt{N}$	N	N^2	$\sqrt{N}$	N	N^2	$\sqrt{N}$
1	1	1.00	51	2,601	7.14	101	10,201	10.05
2	4	1.41	52	2,704	7.21	102	10,404	10.10
3	9	1.73	53	2,809	7.28	103	10,609	10.15
4	16	2.00	54	2,916	7.35	104	10,816	10.20
5	25	2.24	55	3,025	7.42	105	11,025	10.25
6	36	2.45	56	3,136	7.48	106	11,236	10.30
7	49	2.65	57	3,249	7.55	107	11,449	10.34
8	64	2.83	58	3,364	7.62	108	11,664	10.39
9	81	3.00	59	3,481	7.68	109	11,881	10.44
10	100	3.16	60	3,600	7.75	110	12,100	10.49
11	121	3.32	61	3,721	7.81	111	12,321	10.54
12	144	3.46	62	3,844	7.87	112	12,544	10.58
13	169	3.61	63	3,969	7.94	113	12,769	10.63
14	196	3.74	64	4,096	8.00	114	12,996	10.68
15	225	3.87	65	4,225	8.06	115	13,225	10.72
16	256	4.00	66	4,356	8.12	116	13,456	10.77
17	289	4.12	67	4,489	8.19	117	13,689	10.82
18	324	4.24	68	4,624	8.25	118	13,924	10.86
19	361	4.36	69	4,761	8.31	119	14,161	10.91
20	400	4.47	70	4,900	8.37	120	14,400	10.95
21	441	4.58	71	5,041	8.43	121	14,641	11.00
22	484	4.69	72	5,184	8.49	122	14,884	11.05
23	529	4.80	73	5,329	8.54	123	15,129	11.09
24	576	4.90	74	5,476	8.60	124	15,376	11.14
25	625	5.00	75	5,625	8.66	125	15,625	11.18
26	676	5.10	76	5,776	8.72	126	15,876	11.23
27	729	5.20	77	5,929	8.78	127	16,129	11.27
28	784	5.29	78	6,084	8.83	128	16,384	11.31
29	841	5.39	79	6,241	8.89	129	16,641	11.36
30	900	5.48	80	6,400	8.94	130	16,900	11.40
31	961	5.57	81	6,561	9.00	131	17,161	11.45
32	1,024	5.66	82	6,724	9.06	132	17,424	11.49
33	1,089	5.74	83	6,889	9.11	133	17,689	11.53
34	1,156	5.83	84	7,056	9.17	134	17,956	11.58
35	1,225	5.92	85	7,225	9.22	135	18,225	11.62
36	1,296	6.00	86	7,396	9.27	136	18,496	11.66
37	1,369	6.08	87	7,569	9.33	137	18,769	11.71
38	1,444	6.16	88	7,744	9.38	138	19,044	11.75
39	1,521	6.24	89	7,921	9.43	139	19,321	11.79
40	1,600	6.33	90	8,100	9.49	140	19,600	11.83
41	1,681	6.40	91	8,281	9.54	141	19,881	11.87
42	1,764	6.48	92	8,464	9.59	142	20,164	11.92
43	1,849	6.56	93	8,649	9.64	143	20,449	11.96
44	1,936	6.63	94	8,836	9.70	144	20,736	12.00
45	2,025	6.71	95	9,025	9.75	145	21,025	12.04
46	2,116	6.78	96	9,216	9.80	146	21,316	12.08
47	2,209	6.86	97	9,409	9.85	147	21,609	12.12
48	2,304	6.93	98	9,604	9.90	148	21,904	12.17
49	2,401	7.00	99	9,801	9.95	149	22,201	12.21
50	2,500	7.07	100	10,000	10.00	150	22,500	12.25

Using Square Root to Find Missing Dimensions



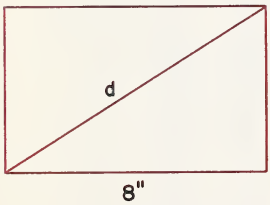
We learned that the square on the hypotenuse of a right triangle is equal to the sum of the squares on the other two sides, or $c^2 = a^2 + b^2$. The use of this formula enables us to find any side of a right triangle when two of its sides are given.

1. Find the length of the hypotenuse of the right triangle shown on the left above.

The formula:	$c^2 = a^2 + b^2$
Substitute numbers given:	$c^2 = 12^2 + 9^2$
or	$c^2 = 144 + 81$
or	$c^2 = 225$
Take square root of both members:	$c = 15$

(See table on page 333.) The hypotenuse is 15 feet.

2. One arm of a right triangle is 5 inches and the other arm is 12 inches. What is the length of the hypotenuse?



3. The diagonal of a rectangle divides the figure into two equal right triangles. To the nearest tenth of an inch, what is the length of the diagonal of the rectangle on the left?

4. To the nearest tenth of an inch, find the length of the diagonal of a square having a side of 4 in.; of 6 in.; of 8 in.

★5. The distance from one base to the next base on a baseball diamond is 90 feet. To the nearest foot, what is the distance from home plate to second base?

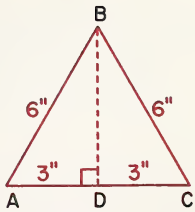
★6. The distance from one base to the next base on a diamond for softball is 60 feet. To the nearest foot, what is the distance from home plate to second base?

★7. To the nearest foot, find the length of a diagonal in each of the following rectangles:

	Length	Width		Length	Width		Length	Width
a.	10 ft.	8 ft.	c.	45 ft.	35 ft.	e.	100 ft.	64 ft.
b.	25 ft.	18 ft.	d.	75 ft.	54 ft.	f.	120 ft.	72 ft.

Finding Any Side of a Right Triangle

The altitude of an equilateral triangle bisects the base of the triangle. In the triangle ABC, BD is the altitude. In the formula $c^2 = a^2 + b^2$, c represents the hypotenuse and a and b represent the arms of the triangle. If we let c represent AB, and b represent AD, then a represents BD.



1. To the nearest tenth of an inch, what is the length of the altitude BD?

The formula:	$c^2 = a^2 + b^2$
We can also write:	$a^2 + b^2 = c^2$
Substitute the numbers given:	$a^2 + 3^2 = 6^2$
We then have:	$a^2 + 9 = 36$
Subtract 9 from both members:	$9 = 9$
	$a^2 = 27$
Take the square root of both members:	$a = 5.20$

(See table on page 333.)

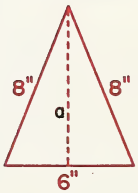
To the nearest tenth of an inch, BD = 5.2 inches.

2. In problem 1, what is the area of the triangle?

3. To the nearest tenth, find the altitude of an equilateral triangle having a side of 8 ft.; of 5 ft.; of 2 yd.

4. Find the area of each triangle in problem 3.

5. The altitude bisects the base of an isosceles triangle. To the nearest tenth of an inch, what is the altitude of the isosceles triangle on the right? What is the area of this triangle?



★6. In a right triangle, the square on the hypotenuse is equal to the sum of the squares on the two arms. Which of the following represent the dimensions of a right triangle?

a. 9, 12, 15 b. 4, 8, 10 c. 5, 12, 13 d. 36, 40, 10
e. 15, 25, 31

Approximate Square Roots

From the table (page 333), find the approximate square root of 741.

741 is not in the table. But 741 is between 729 and 784, both of which are perfect squares and are in the table.

$\sqrt{729}$ is 27, and the $\sqrt{784}$ is 28.

741 is less than halfway between 729 and 784; hence, the square root of 741 is between 27.0 and 27.5

The squares of 27.1, 27.2, and 27.3 are shown.

$$27.1^2 = 734.41$$
$$27.2^2 = 739.84$$
$$27.3^2 = 745.29$$

The square root of 741, to the nearest tenth, is 27.2.

2. Between what two numbers in the table is 4513? To which of these numbers is it closer?

3. Between what two numbers in the table is 9337? To which of these numbers is it closer?

4. Between what two numbers in the table is 5838? To which of these numbers is it closer?

5. Find, to the nearest tenth, the square root of: 483 6. 1865 7. 4343 8. 7000

★9. A square has an area of 163.84 square inches. What is the length of a side?

The side must be between 12 inches and 13 inches. Why? The exact value can be read from the table in the column of squares for three-place numbers.

★10. A square has an area of 210.25 square feet. What is the length of a side?

★11. Find, to the nearest tenth, the length of the side of a square which has an area of 154.36 square inches.

Approximate Square Roots by Division

If you do not have a table of squares and square roots, you can find the approximate square root of a number by division.

1. Find by division the approximate square root of 1856.

The square root of 1856 is between 40 and 50, because $40^2 = 1600$ and $50^2 = 2500$.

As 1856 is nearer to 1600 than to 2500, try 43 as a divisor.

When 1856 is divided by 43, the quotient to the nearest hundredth is 43.16.

The approximate square root of 1856 is the average of the divisor and quotient, or

$$\frac{43 + 43.16}{2} = \frac{86.16}{2} = 43.08$$

To the nearest tenth, the approximate square root is 43.1.

Check: $43.1 \times 43.1 = 1857.61$

```
      43.16
43) 1856.00
    172
    136
    129
     70
     43
    270
    258
     12
```

2. If the square root to be found were midway between 40^2 and 50^2, what number would be used as a divisor?

3. Between what two values is the square root of:

a. 72	b. 130	c. 790	d. 2732
e. 5144	f. 6198	g. 8950	h. 9124

Using the division method, find to the nearest tenth the approximate square root of each of the following numbers:

4. 50	7. 1340	10. 3285	13. 7025
5. 180	8. 1492	11. 5100	★14. 80.34
6. 670	9. 2131	12. 6000	★15. 24.27

Practise What You Have Learned

1. $\begin{array}{r} 376 \\ 957 \\ 2408 \\ 671 \\ 3543 \\ 95 \\ \hline \end{array}$

2. $\begin{array}{r} 41{,}314 \\ -25{,}648 \\ \hline \end{array}$

3. $\begin{array}{r} 736 \\ \times 408 \\ \hline \end{array}$

4. $\begin{array}{r} 138 \\ \times 5\frac{3}{4} \\ \hline \end{array}$

5. $\begin{array}{r} 2\frac{1}{2} \\ 4\frac{1}{3} \\ 2\frac{5}{6} \\ 8\frac{3}{4} \\ \hline \end{array}$

6. $351\overline{)22436}$

7. $\begin{array}{r} 4.35 \\ \times 5.6 \\ \hline \end{array}$

8. $\begin{array}{r} .725 \\ -.575 \\ \hline \end{array}$

9. $2\frac{1}{2} \times \frac{7}{8} =$

10. $1\frac{1}{4} \times 3\frac{1}{2} \times 3\frac{1}{7} =$

11. $\frac{4}{5} \times 6\frac{2}{3} =$

12. $\frac{3}{4} \div 1\frac{1}{4} =$

13. $2\frac{1}{2} \div 1\frac{3}{4} =$

14. $1.5\overline{).24}$

15. $\frac{1}{2}\%$ of 1260 =

16. 2.4% of 960 =

17. 30 = ?% of 25

18. 4 = ?% of 80

19. 5% of ? = 40

20. 60 = 12% of ?

Solving Equations and Formulas

Solve and check each of the following equations:

	a	b	c	d
1.	$3x = 15$	$a + 5 = 9$	$b - 4 = 6$	$2a + 5 = 7$
2.	$21 = x + 15$	$3r - 2 = 7$	$2m + 5 = 6$	$50 = 10 + 4n$
3.	$2x + 15 = 75$	$3b - 15 = 15$	$75 = 2x - 25$	$n + 5 = 5$
4.	$30 = \frac{3a}{4}$	$\frac{2x}{3} = 10$	$\frac{n}{4} = 8$	$\frac{5x}{6} = 20$

5. Use the formula for the area of a rectangle.
   a. If $A = 75$ and $l = 15$, what is w?
   b. If $A = 360$ and $w = 15$, what is l?
6. Use the formula for the area of a triangle.
   a. If $A = 36$ and $b = 8$, what is h?
   b. If $A = 120$ and $h = 15$, what is b?
7. Use the formula for the volume of a prism.
   a. If $V = 72$, $w = 6$, and $l = 8$, what is h?
   b. If $V = 450$, $l = 15$, and $h = 10$, what is w?
   c. If $V = 360$, $w = 4$, $h = 10$, what is l?

Review of Per Cent

1. Express as per cents:

a. $\frac{3}{4}$ b. .2 c. 1.3 d. $\frac{5}{8}$ e. $1\frac{1}{3}$ f. .034 g. 2

2. Write as a common fraction or as a whole number:

a. 50% b. $33\frac{1}{3}\%$ c. 300% d. $37\frac{1}{2}\%$ e. 40% f. $12\frac{1}{2}\%$

Find the missing numbers in each of the following:

a	b	c
3. 3% of 75 = ?	5 = ?% of 4	10 = 2% of ?
4. 120% of 60 = ?	30 = ?% of 20	20 = 5% of ?
5. 2.4% of 620 = ?	6 = ?% of 25	150% of ? = 60
6. $\frac{1}{4}\%$ of 2740 = ?	1 = ?% of 200	200% of ? = 180

If you are unable to solve any of the following problems, turn for help to the page given in parentheses.

7. What is the per cent of change from 20 to 25? What is the per cent of change from 25 to 20? (105)

8. A basketball team won 14 games and lost 11 games. What per cent of the games played did the team win? (98)

9. There are 28 students enrolled in a class. If 25 students are present, to the nearest per cent, what per cent of the number enrolled are present? (100)

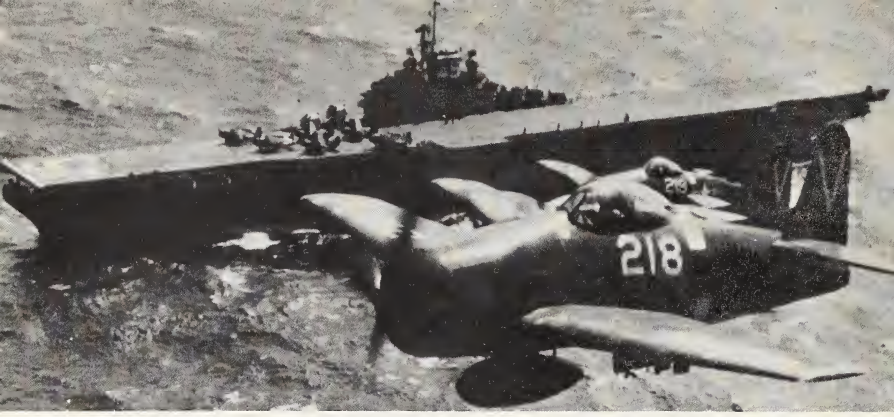
10. At a recent date, the cost to insure deposits in a bank was $\frac{1}{12}\%$ of the amount of the deposits. If the deposits in a bank were $1,800,000, what was the cost to insure them? (102)

11. A man sold a used car at 60% of the price he paid for it when new. If he received $1350 for the car, how much had he originally paid for it? (108)

12. Find the net cost of goods listed at $750 less two discounts of 20% and 5%. (120)

13. A merchant paid $45 for a suit. He marked it up to sell for $75. The mark-up was what per cent of the cost? (98)

14. A book sold for $2.40 at 80% of the list price. What was the list price? (108)



Reviewing Area

1. If the deck of the airplane carrier is a rectangle 860 feet long and 90 feet wide, what is the area of this surface? (129)

2. The perimeter of a square is 36 inches. What is the area of the square? (129)

3. The length of the diagonal of a square is 1.4 times the length of a side. What is the length of the diagonal of a square having a side of 8 feet? (55)

4. Use the necessary data from problem 3 to find the length of a side of a square having a diagonal of 7 inches. (69)

5. The area of one of the triangles formed by a diagonal of a parallelogram is 32 square inches. What is the area of the parallelogram? (145)

6. The weight of snow 10 inches deep on 100 square feet of surface is approximately 520 pounds. At that rate, to the nearest 100 pounds, find the weight of snow 5 inches deep on a rectangular surface $32' \times 20'$; on a rectangular surface $45' \times 56'$. (133)

7. A circle has a diameter of 60 feet. How many feet are there in the circumference? ($\pi = 3.14$) (149)

8. Find the area of the circle in problem 7. (152)

9. Show that a circular running track, having a diameter of 140 yards, will have a circumference of a quarter mile (440 yd.). ($\pi = \frac{22}{7}$) (149)

Reviewing Interest and Investments

Find the interest on each of the following:

	Principal	Rate	Time		Principal	Rate	Time
1.	\$450	5%	$1\frac{1}{2}$ yr.	6.	\$400	6%	60 da.
2.	\$750	4%	$\frac{1}{2}$ yr.	7.	\$650	4%	90 da.
3.	\$1200	$3\frac{1}{2}$%	2 yr.	8.	\$720	5%	45 da.
4.	\$1500	3%	3 mo.	9.	\$1200	$4\frac{1}{2}$%	60 da.
5.	\$2250	6%	$\frac{1}{4}$ yr.	10.	\$3000	5%	30 da.

11. Find the yearly rate of interest if the rate is $\frac{1}{2}$% a month; if the rate is $1\frac{1}{2}$% quarterly. (169)

12. If the yearly rate of interest is 2%, what is the semiannual rate? (169)

13. The cash price of a television set is \$240. If bought on the instalment plan, there is a down payment of 25% and \$13.54 a month for 15 months. How much more is the instalment price than the cash price? (178–179)

14. What is the compound interest on \$500 at 3% for 2 years if the interest is compounded annually? (194)

15. A Canada Savings Bond for \$1000 was issued on Nov. 1, 1953. The coupon rate was $3\frac{3}{4}$%. What was the redemption value of the bond on Nov. 1, 1954.

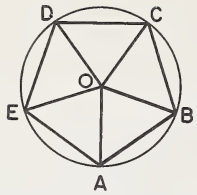
16. The market value of a share of stock is quoted at $27\frac{3}{4}$. What is the cost, without brokerage, of 100 shares of this stock? (206)

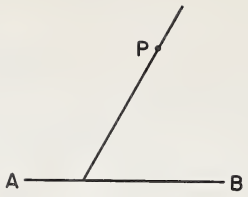
17. A house is insured for \$7200 against loss by fire. The rate of insurance is 24¢ per \$100 a year. Find the yearly cost of the insurance. (211)

18. The rate for fire insurance for 3 years is $2\frac{1}{2}$ times the rate for one year. In problem 17, find the premium for a 3-year period on a policy of \$7200. (212)

19. The rate for insuring a cargo of 100,000 bu. of grain valued at \$2.25 a bu. is $\frac{1}{4}$%. Find the premium to insure the wheat. (102)

20. A man 30 years of age takes out a 20-payment life insurance policy. If the yearly premium on \$1000 is \$34.18, what is the yearly premium on a policy of \$7500? (219)





Reviewing Geometry

1. Draw a line $3\frac{1}{2}$ inches long and bisect it at right angles. Check your construction with a ruler and protractor. (228)

2. Draw an angle of 75° and bisect it. Check your construction with a protractor. (228)

3. Make a copy of the drawing at the right above. Through the point P construct a line parallel to AB. (230)

4. Inscribe a regular hexagon in a circle having a radius of 2 inches. (233)

5. In problem 4, what is the perimeter of the hexagon? (128)

6. What kind of figure is ABCDE at the left above? (234)

7. How many degrees are in each central angle at O? (155)

8. From paper, cut two triangles which are congruent. (236)

9. Draw triangles which are equivalent, but not congruent. (237)

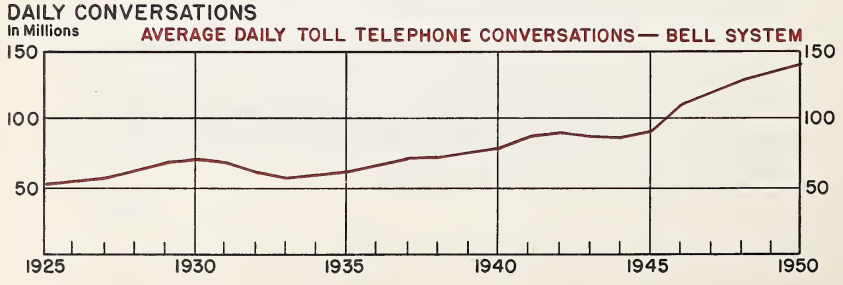
10. Draw an equilateral triangle and then draw an axis of symmetry. (238)

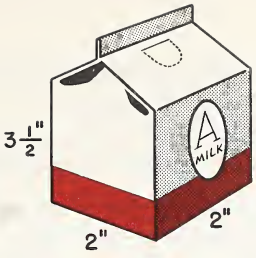
11. What is the caption of the graph below?

12. Approximately how many telephone calls were made daily in 1925? in 1940? in 1950? (251)

13. In approximately which year did the number of daily telephone calls reach 100 million? (251)

★14. Make a copy of the graph.





Reviewing Solids

1. A rectangular carton which has inside dimensions the same as those shown in the picture will hold about half a pint of milk. How many cubic inches are there in the carton? (262)

2. What is the volume of a cube 4 inches on a side? (266)

3. In problem 2, what is the total area of the cube? (129, 266)

4. What kind of unit is used to measure volume? What kind of unit is used to measure area? (129, 262)

5. An aquarium 22 inches long, 14 inches wide, is filled with water to a depth of 12 inches. Allowing 277.3 cubic inches per gallon, how many gallons of water does the aquarium hold? (262)

6. A cylindrical can has a diameter of 7 inches and a height of 12 inches. Use the necessary data from problem 5 to find how many gallons the can will hold when filled. ($\pi = \frac{22}{7}$) (270)

7. A pyramid has a square base 4 feet on a side. If the height of the pyramid is 6 feet, what is the volume of the solid? (274)

8. Find the number of board feet in a piece of lumber 16 feet long, 6 inches wide, and 2 inches thick. (282)

9. At $275 per M, find the cost of 1250 board feet of oak flooring. (282–283)

10. If it is 9:30 A.M., E.S.T., in Montreal, P.Q., what is the standard time on the Pacific coast? (279)

11. What is the difference in standard time between two places which have a difference in longitude of 60°? a difference in longitude of 135°? (278)

12. The difference in longitude between London and Winnipeg is about 97°. When it is noon in Winnipeg, what is the standard time in London? (278)

Reviewing Taxation

"A tax is a payment exacted by authority from part of the community for the benefit of the whole."—Samuel Johnson.

1. In the above quotation, what is meant by the statement "by authority"? Is this statement true?

2. Name at least three services supported by taxes which are for the benefit of all people in the community. (290)

3. When the assessed valuation and the amount of the yearly budget are known, how do we find the tax rate? (293)

4. Express the tax rate as a per cent when the assessed valuation is \$1,500,000 and the amount of the yearly budget is \$60,000? (294)

5. The assessed value of a property is \$5600. If the tax rate is \$4.78 on \$100, what is the yearly tax on the property? (294)

6. A man has a wife and two dependent children. He is allowed \$1000 exemption from income tax for himself and his wife, \$150 for each child and \$300 for other exemptions. If his income is \$4250, what is his net income after subtracting exemptions for income tax? (300)

7. The gasoline tax in a certain province is 15¢ a gallon of gasoline. Find the provincial gasoline tax paid by a motorist when he drove his car 12,000 miles in that province at an average of 20 miles per gallon of gasoline. (296)

8. At a recent date, the taxes paid by our largest telephone company averaged \$2.65 per telephone per month. At that rate, what was the yearly tax paid on each telephone in operation in this country? (295)

9. When the telephone company pays the tax is this tax a direct tax or an indirect tax on the family that has a telephone in its home? (295)

10. Find the cost of a \$1000 bond quoted at $103\frac{1}{2}$. (306)

11. In problem 10, the bond pays $4\frac{1}{2}\%$ interest. What is the semiannual interest on the bond? (306)

12. If the semiannual interest on a \$1000 bond is \$25, what is the rate of interest? (306)

MORE PRACTICE

388

Getting Ready for the Progress Test in the Fundamentals

I. Add:

1. $\begin{array}{r} 756 \\ 2388 \\ 57 \\ 904 \\ \underline{4639} \end{array}$

2. $\begin{array}{r} \frac{1}{2} \\ \frac{2}{3} \\ \frac{5}{6} \\ \frac{11}{12} \end{array}$

3. $\begin{array}{r} 6\frac{1}{4} \\ 8\frac{5}{6} \\ 2\frac{1}{2} \\ \underline{7\frac{1}{3}} \end{array}$

4. $\begin{array}{r} 5.68 \\ 9.35 \\ 0.87 \\ \underline{4.35} \end{array}$

5. $\begin{array}{r} 6 \text{ min. } 38 \text{ sec.} \\ 4 \text{ min. } 26 \text{ sec.} \\ \underline{45 \text{ sec.}} \end{array}$

6. $\begin{array}{r} 5 \text{ lb. } 12 \text{ oz.} \\ \underline{2 \text{ lb. } 9 \text{ oz.}} \end{array}$

II. Subtract:

1. $\begin{array}{r} 7416 \\ \underline{2387} \end{array}$

2. $\begin{array}{r} 40{,}102 \\ \underline{30{,}258} \end{array}$

3. $\begin{array}{r} 6004 \\ \underline{9} \end{array}$

4. $\begin{array}{r} 9 \\ \underline{3\frac{5}{8}} \end{array}$

5. $\begin{array}{r} 16\frac{1}{4} \\ \underline{8\frac{1}{2}} \end{array}$

6. $\begin{array}{r} .740 \\ \underline{.356} \end{array}$

7. $\begin{array}{r} 5.725 \\ \underline{2.455} \end{array}$

8. $\begin{array}{r} 9\frac{3}{8} \\ \underline{6\frac{3}{4}} \end{array}$

9. $\begin{array}{r} 12 \text{ ft. } 8 \text{ in.} \\ \underline{8 \text{ ft. } 10 \text{ in.}} \end{array}$

III. Multiply:

1. $\begin{array}{r} 567 \\ \underline{49} \end{array}$

2. $\begin{array}{r} 480 \\ \underline{70} \end{array}$

3. $\begin{array}{r} 609 \\ \underline{106} \end{array}$

4. $\begin{array}{r} 37 \\ \underline{.27} \end{array}$

5. $\begin{array}{r} 4.6 \\ \underline{1.5} \end{array}$

6. $\frac{3}{4} \times 2\frac{1}{2} =$

7. $6\frac{1}{4} \times 3\frac{1}{2} \times 3\frac{1}{7} =$

8. $5\frac{1}{4} \times \frac{3}{8} =$

9. 103% of 480 =

10. $\frac{1}{4}\%$ of 1740 =

11. $37\frac{1}{2}\%$ of 960 =

IV. Divide:

1. $7\overline{)5134}$

2. $28\overline{)2046}$

3. $365\overline{)24790}$

4. $1.6\overline{).92}$

5. $.02\overline{)33}$

6. $3.2\overline{)1.6}$

7. $\frac{5}{8} \div 2\frac{1}{2} =$

8. $120 \div 2\frac{1}{2} =$

9. $2 \div 3\frac{1}{2} =$

10. $\frac{7}{8} =$?%

11. $1\frac{3}{4} =$?%

12. 17 = ?% of 20

13. 30 = 5% of ?

14. 120% of ? = 60

15. 24 = ?% of 18

16. 1 = ?% of 50

17. $3\overline{)16 \text{ min. } 12 \text{ sec.}}$

18. $2\overline{)7 \text{ ft. } 5 \text{ in.}}$

19. If 120% of a number is 75, what is the number?

Chapter Test

1. To find which of the following would it very probably be necessary to use indirect measurement?

a. The width of a street
b. The distance to the moon
c. The height of a cloud
d. The depth of the ocean
e. The height of a garage
f. The speed of a bullet

2. Find the ratio of:

a. \$3 to \$5
b. 2 lb. to 10 lb.
c. 10 oz. to 1 lb.
d. 1 yd. to 18 in.
e. 4 da. to 1 wk.
f. 5 qt. to 1 gal.
g. A dime to a dollar
h. 10 min. to 1 hr.
i. 5 mm. to 1 cm.

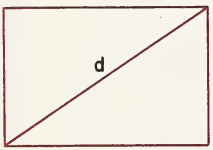
3. A soft drink is 3 parts of water and 1 part of frozen fruit juice. How much fruit juice does it take to make 12 pints of the drink?

4. A man 6 feet tall casts a shadow 5 feet long. What is the height of a chimney which, at the same time, casts a shadow 65 feet long?

5. Solve and check each of the following equations:

a. $x + 3 = 5$
b. $n - 5 = 6$
c. $p + 1 = 7$
d. $\frac{x}{3} = 5$
e. $4x = 24$
f. $50 = x + 8$
g. $7r = 231$
h. $\frac{n}{5} = 40$
i. $12x = 27$
j. $50 = 25n$
k. $30 = 60x$
l. $\frac{5n}{8} = 120$

6. Select the numbers from the following which are perfect squares: 2, 16, 20, 100, 125, 144, 400, 500, 1000.



7. Find the length of the diagonal of a rectangle which has the same dimensions as those given in the figure on the left.

8. A square has a side of 8 inches. To the nearest tenth of an inch, what is the length of a diagonal? (Use the table on page 333.)

9. Find by division the approximate square root of the following: 2641; 6359; 8875.

Progress Test in the Fundamentals

Solve the following examples:

1. (48)	2. (8)	3. (11)	4. (55)	5. (25)
.355 .908 .675 .483	43,125 −5,684	904 ×708	6.8 ×4.5	$7\frac{2}{3}$ $-1\frac{3}{4}$

6. $28\overline{)2056}$ (16)

7. $372\overline{)28506}$ (16)

8. $2.4\overline{)6}$ (69)

9. $\frac{3}{4} \times 6\frac{1}{2} =$ (29)

10. $3\frac{1}{7} \times 6\frac{2}{3} \times 6\frac{2}{3} =$ (29)

11. $\frac{7}{8} \div 2\frac{1}{2} =$ (34)

12. $180 \div 3\frac{3}{4} =$ (34)

13. $4.5 \div .001 =$ (71)

14. $\frac{3}{7}$ to nearest 0.01 = (67)

15. 3.4% of 360 = (92)

16. $\frac{1}{2}$% of 2540 = (102)

17. 36 = ?% of 25 (98)

18. 450 = 150% of ? (108)

19. 17 = ?% of 50 (98)

20. 3% of ? = 36 (108)

If you did not understand how to work an example, turn to the page number where the process is explained.

★For Those Who Made No Errors on the Above Test

The following examples are numbered to correspond to the number in the square on the right. The answers to the examples, arranged in the order shown in the square, form a magic square.

1	2	3	4
5	6	7	8
9	10	11	12
13	14	15	16

Draw a square of 16 cells and write the answers to the following examples in the spaces so as to form a magic square. What is the sum of the numbers in each row, each column, or along each diagonal in the square you have made?

1. $\frac{3}{4} \times 1\frac{7}{9} =$
2. $20 \times \frac{1}{120} =$
3. $25 \div 100 =$
4. $\frac{7}{12} + \frac{1}{2} =$
5. $1\frac{1}{2} - \frac{1}{2} =$
6. $2\frac{1}{4} - 1\frac{1}{3} =$
7. $\frac{1}{2} + \frac{1}{3} =$
8. $\frac{1}{2} \div \frac{3}{4} =$
9. $\frac{1}{2} + \frac{1}{4} =$
10. $1\frac{1}{2} - \frac{1}{3} =$
11. $.5 \div 1 =$
12. $.76 \div .76 =$
13. $\frac{1}{2}$ of $\frac{2}{3} =$
14. $\frac{7}{8} \times 1\frac{1}{3} =$
15. $1\frac{2}{3} \times \frac{3}{4} =$
16. $\frac{1}{3} - \frac{1}{4} =$

Test in Problem Solving

Solve the following problems. If you are unable to solve a problem, turn for help to the page indicated on the right.

1. In a recent year the average fare per passenger trip on railroads was \$1.95. At an average of $2\frac{1}{2}¢$ a mile, what was the length of the average trip? (34)

2. The population of a town increased from 5000 to 6000. What was the per cent of increase in population? (105)

3. The perimeter of a square is 48 feet. What is the area of the square? (129)

4. How many days are there from March 15 to the following June 1? (175)

5. The semi-annual interest on a loan of \$500 is \$12.50. What is the rate of interest? (169)

6. What is the coupon value on a \$500 Series 8 Canada Savings Bond, six months after date of issue? (200)

7. What is the perimeter of a regular hexagon which is inscribed in a circle having a diameter of 3 inches? (233)

8. Express a tax rate of 4.87% as dollars on \$100 of assessed valuation. (294)

9. A stick 10 feet high casts a shadow 7 feet long. At the same time, the length of the shadow of a flagpole is 35 feet. What is the height of the flagpole? (320)

10. One arm of a right triangle is 8 inches and the other arm is 15 inches. What is the length of the hypotenuse of the right triangle? (331)

Tables for Reference

Linear Measure or Measures of Length

12 inches (in.)	= 1 foot (ft.)	320 rods	= 1 mile (mi.)
3 feet	= 1 yard (yd.)	1760 yards	= 1 mile
5.5 yards	= 1 rod (rd.)	5280 feet	= 1 mile
		1 nautical mile	= 6080 feet

Square Measure or Measures of Surface

144 square inches (sq. in.)	= 1 square foot	(sq. ft.)
9 square feet	= 1 square yard	(sq. yd.)
30.25 square yards	= 1 square rod	(sq. rd.)
160 square rods	= 1 acre	(A.)
640 acres	= 1 square mile	(sq. mi.)

Cubic Measure or Measures of Volume

1728 cubic inches (cu. in.)	= 1 cubic foot	(cu. ft.)
27 cubic feet	= 1 cubic yard	(cu. yd.)
128 cubic feet	= 1 cord of wood of 4-ft. length	

Important Volume Equivalents

1 cubic foot	= 6.229 gallons	(gal.)
1 cubic foot of water	= 62.5 pounds	(lb.)
1 cubic foot	= 0.8 bushel	(bu.)
1 gallon	= 277.3 cubic inches	(cu. in.)

Measures of Weight

16 ounces (oz.)	= 1 pound	(lb.)
100 pounds	= 1 hundredweight	(cwt.)
2000 pounds	= 1 ton	(T.)

Liquid Measures

20 fluid oz. (fl. oz.)	= 1 pint	(pt.)
2 pints	= 1 quart	(qt.)
4 quarts	= 1 gallon	(gal.)
35 gallons	= 1 barrel	(bbl.)

Dry Measures

2 pints (pt.)	= 1 quart	(qt.)
8 quarts	= 1 peck	(pk.)
4 pecks	= 1 bushel	(bu.)
3 bushels	= 1 barrel	(bbl.)

Metric Measures of Length and Linear Measure Equivalents

10 millimeters (mm.)	= 1 centimeter	(cm.), about .4 inch
10 centimeters	= 1 decimeter	(dm.), about 4 inches
10 decimeters	= 1 meter	(m.), nearly 40 in. (39.37)
1000 meters	= 1 kilometer	(km.), about $\frac{5}{8}$ mile

ANSWERS TO DIAGNOSTIC TESTS

Addition of Whole Numbers (Page 8)

I.	a. 36	b. 37	c. 41
II.	a. 369	b. 392	c. 413
III.	a. 3464	b. 4241	c. 3226
IV.	a. 2299	b. 2464	c. 12,588

Subtraction of Whole Numbers (Page 8)

I.	a. 625	b. 193	c. 83
II.	a. 278	b. 566	c. 2875
III.	a. 577	b. 196	c. 496
IV.	a. 5317	b. 2914	c. 6995

Multiplication of Whole Numbers (Page 11)

I.	a. 3496	b. 5376	c. 30,360
II.	a. 1634	b. 34,060	c. 39,396
III.	a. 143,488	b. 187,542	c. 184,050
IV.	a. 183,120	b. 339,500	c. 4,883,200

One-Place Divisors (Page 14)

I.	a. 792	b. 2393 r1	c. 653 r2
II.	a. 2407	b. 1470	c. 980 r2
III.	a. 638 r6	b. 688 r8	c. 874 r5
IV.	a. 275	b. 183 r13	c. 46 r45

Division With Two-Or-More-Place Divisors (Page 17)

I.	a. 36 r20	b. 92 r26	c. 82 r13
II.	a. 307	b. 80	c. 170 r5
III.	a. 257 r1	b. 343 r23	c. 48 r32
IV.	a. 60 r19	b. 82 r8	c. 537 r13
V.	a. 30 r296	b. 17 r152	c. 73 r53
VI.	a. 370 r3	b. 470 r13	c. 504 r316

Addition of Fractions (Page 23)

I.	a. $\frac{4}{5}$	b. $1\frac{2}{9}$	c. $1\frac{1}{10}$	d. $15\frac{2}{3}$	e. $4\frac{2}{5}$
II.	a. $1\frac{1}{4}$	b. $1\frac{1}{3}$	c. 1	d. $11\frac{2}{3}$	e. 8
III.	a. $1\frac{1}{12}$	b. $1\frac{1}{4}$	c. $1\frac{1}{6}$	d. $11\frac{1}{4}$	e. $4\frac{1}{10}$
IV.	a. $\frac{4}{5}$	b. $1\frac{1}{3}$	c. $1\frac{1}{2}$	d. $15\frac{2}{3}$	e. $5\frac{1}{3}$
V.	a. $1\frac{1}{6}$	b. $1\frac{1}{12}$	c. $1\frac{1}{12}$	d. $11\frac{7}{12}$	e. $9\frac{17}{24}$
VI.	a. $2\frac{1}{24}$	b. $1\frac{7}{12}$	c. $1\frac{11}{18}$	d. $15\frac{1}{4}$	e. $6\frac{11}{24}$

Subtraction of Fractions (Page 26)

I.	a. $\frac{3}{8}$	b. $\frac{1}{2}$	c. $3\frac{1}{2}$	d. $\frac{2}{3}$	e. 2
II.	a. $\frac{1}{8}$	b. $\frac{2}{5}$	c. $3\frac{1}{3}$	d. $5\frac{3}{10}$	e. $\frac{1}{2}$
III.	a. $\frac{1}{12}$	b. $\frac{5}{24}$	c. $5\frac{7}{12}$	d. $6\frac{5}{12}$	e. $6\frac{1}{10}$
IV.	a. $3\frac{2}{3}$	b. $\frac{1}{5}$	c. $\frac{1}{6}$	d. $1\frac{1}{4}$	e. $4\frac{1}{8}$
V.	a. $\frac{2}{5}$	b. $\frac{1}{3}$	c. $\frac{2}{3}$	d. $9\frac{1}{2}$	e. $6\frac{1}{2}$
VI.	a. $2\frac{5}{6}$	b. $\frac{5}{8}$	c. $8\frac{2}{3}$	d. $\frac{1}{2}$	e. $6\frac{5}{8}$
VII.	a. $2\frac{11}{12}$	b. $2\frac{9}{10}$	c. $\frac{5}{12}$	d. $2\frac{5}{6}$	e. $9\frac{19}{24}$

Multiplication of Fractions (Page 30)

I.	a. 9	b. $\frac{3}{4}$	c. $2\frac{2}{5}$	d. $12\frac{1}{2}$
II.	a. 10	b. $13\frac{1}{3}$	c. $\frac{3}{4}$	d. $52\frac{1}{2}$
III.	a. $\frac{5}{16}$	b. $\frac{5}{12}$	c. $\frac{3}{4}$	d. $\frac{11}{27}$
IV.	a. $1\frac{1}{8}$	b. $2\frac{2}{3}$	c. $7\frac{7}{8}$	d. $\frac{5}{6}$
V.	a. $71\frac{1}{2}$	b. $261\frac{1}{3}$	c. $137\frac{1}{2}$	d. $526\frac{1}{2}$
VI.	a. $5\frac{5}{64}$	b. 273	c. $13\frac{1}{5}$	

Division of Fractions (Page 35)

I.	a. 20	b. $10\frac{1}{2}$	c. $10\frac{1}{2}$	d. $13\frac{1}{3}$
II.	a. 2	b. $\frac{24}{25}$	c. 1	d. $1\frac{1}{20}$
III.	a. $\frac{3}{8}$	b. $\frac{7}{24}$	c. $\frac{1}{5}$	d. $\frac{1}{12}$
IV.	a. $\frac{5}{8}$	b. $2\frac{1}{6}$	c. 2	d. $\frac{9}{14}$
V.	a. $\frac{9}{20}$	b. $2\frac{2}{9}$	c. 2	d. $\frac{39}{44}$
VI.	a. $\frac{3}{7}$	b. $\frac{3}{4}$	c. $\frac{5}{16}$	d. $\frac{2}{3}$

Addition of Decimals (Page 49)

I.	**a.** 2.8	**b.** 2.88	**c.** 19.62
II.	**a.** 1.726	**b.** 1.288	**c.** 10.196
III.	**a.** .14	**b.** .170	**c.** 2.710
IV.	**a.** 11.85	**b.** 10.17	**c.** 2.47

Subtraction of Decimals (Page 49)

I.	**a.** .33	**b.** 4.16	**c.** 3.58
II.	**a.** .217	**b.** .497	**c.** .893
III.	**a.** .065	**b.** .091	**c.** .007
IV.	**a.** 3.25	**b.** .045	**c.** 1.82

Multiplication of Decimals (Page 63)

I.	**a.** 14.8	**b.** 5.36	**c.** .875	
II.	**a.** 27.6	**b.** 6.48	**c.** 2101.6	
III.	**a.** 16.8	**b.** 33.12	**c.** .5152	
IV.	**a.** .09	**b.** .0378	**c.** .0625	
V.	**a.** 710; 7100	**b.** 35.8; 358	**c.** 6.5; 65	**d.** 314.16; 3141.6

Division of Decimals (Page 75)

I.	**a.** .28	**b.** .8	**c.** 4.3	**d.** .13
II.	**a.** .07	**b.** .055	**c.** .05	**d.** .0155
III.	**a.** .625	**b.** 4.6	**c.** 1.25	**d.** 6.5
IV.	**a.** 15	**b.** 170	**c.** 12.5	**d.** 16.8
V.	**a.** .45	**b.** .64	**c.** 2.8	**d.** 4
VI.	**a.** .78	**b.** 1.29	**c.** .27	**d.** 4.17

Per Cent (Page 115)

I. **1.** .3 **2.** 1.4 **3.** 4 **4.** .025 **5.** 1.02 **6.** .35 **7.** .03 **8.** .375

II. **1.** 40% **2.** 120% **3.** 52% **4.** 103% **5.** 3.5% **6.** 1.2% **7.** 102.5% **8.** 145%

III. **1.** $\frac{3}{4}$ **2.** $\frac{2}{3}$ **3.** $\frac{3}{8}$ **4.** $\frac{2}{5}$ **5.** $\frac{1}{20}$ **6.** $\frac{1}{10}$ **7.** $\frac{3}{5}$ **8.** $\frac{1}{25}$

IV. 1. 50% 2. 25% 3. 80% 4. $62\frac{1}{2}\%$ 5. 70% 6. 15% 7. 12% 8. 14%

V. 1. a. 2.4 b. 12 c. 17.5 2. a. 3.04 b. 571.2 c. 165 3. a. 2.4 b. 13.8 c. 2.4

VI. 1. a. 25% b. $33\frac{1}{3}\%$ c. 30% 2. a. 250% b. 150% c. 200%

VII. 1. a. 1600 b. 500 c. 2000 2. a. 50 b. \$50 c. 400

SELF HELPS IN ARITHMETIC

Table of Multiplication and Division Facts

The products are found by multiplying the numbers in heavy type at the top of the columns by each number in heavy type at the left margin.

If each product is divided by the number in heavy type in its row on the left margin, the quotient will be the number in heavy type at the top of the column in which the product is found.

	0	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
1	0	1	2	3	4	5	6	7	8	9
2	0	2	4	6	8	10	12	14	16	18
3	0	3	6	9	12	15	18	21	24	27
4	0	4	8	12	16	20	24	28	32	36
5	0	5	10	15	20	25	30	35	40	45
6	0	6	12	18	24	30	36	42	48	54
7	0	7	14	21	28	35	42	49	56	63
8	0	8	16	24	32	40	48	56	64	72
9	0	9	18	27	36	45	54	63	72	81

Addition of Whole Numbers

I. a	b	c	d	e	f	g	h	i
7	5	4	1	2	6	2	5	3
4	8	4	6	4	3	8	4	5
8	3	5	9	9	7	9	5	8
6	6	7	4	5	5	2	8	7
5	7	1	3	8	8	7	3	9
2	9	8	8	3	9	6	9	4

II. a	b	c	d	e	f	g
76	47	53	69	76	84	46
53	57	68	24	42	13	57
29	26	95	86	14	68	69
47	83	79	75	75	33	81
58	95	17	94	72	99	57
82	69	37	67	23	47	71

III. a	b	c	d	e	f	g
692	825	928	539	165	826	929
124	707	339	718	928	473	382
677	664	566	519	850	817	257
468	441	663	378	693	525	982
889	598	205	342	677	488	123
516	816	394	536	921	651	610

IV. a	b	c	d	e	f
716	92	29	574	980	269
36	996	37	968	4594	158
558	647	604	27	658	32
963	550	197	446	72	95
96	37	669	75	3739	9431
118	834	34	519	1454	3896

Answers to Addition of Whole Numbers

I. a. 32, b. 38, c. 29, d. 31, e. 31, f. 38, g. 34, h. 34, i. 36.
II. a. 345, b. 377, c. 349, d. 415, e. 302, f. 344, g. 381.

III. a. 3366, b. 4051, c. 3095, d. 3032, e. 4234, f. 3780, g. 3283.
IV. a. 2487, b. 3156, c. 1570, d. 2609, e. 11,497, f. 13,881.

Subtraction of Whole Numbers

		a	b	c	d	e	f
I.	1.	932	673	871	940	794	785
		418	135	456	238	159	578
	2.	724	607	727	648	934	819
		252	134	466	561	773	293
II.	1.	633	966	442	960	688	4526
		246	278	299	694	389	1879
	2.	855	512	546	324	223	9311
		376	163	487	235	154	8752
III.	1.	706	805	607	208	905	8003
		397	418	169	189	306	2719
	2.	715	300	922	905	805	5006
		207	226	508	646	579	4038

		a	b	c	d	e
IV.	1.	7238	4213	2622	9152	75,022
		457	388	23	504	3,886
	2.	2920	2093	6090	4035	27,755
		467	97	389	157	858

Answers to Subtraction of Whole Numbers

I. 1. a. 514, b. 538, c. 415, d. 702, e. 635, f. 207. 2. a. 472, b. 473, c. 261, d. 87, e. 161, f. 526.

II. 1. a. 387, b. 688, c. 143, d. 266, e. 299, f. 2647. 2. a. 479, b. 349, c. 59, d. 89, e. 69, f. 559.

III. 1. a. 309, b. 387, c. 438, d. 19, e. 599, f. 5284. 2. a. 508, b. 74,

Answers to Subtraction of Whole Numbers —Continued

c. 414, d. 259, e. 226, f. 968.

IV. 1. a. 6781, b. 3825, c. 2599, d. 8648, e. 71,136. 2. a. 2453, b. 1996, c. 5701, d. 3878, e. 26,897.

Multiplication of Whole Numbers

		a	b	c	d	e	f
I.	1.	548 × 6	729 × 3	654 × 7	397 × 8	850 × 9	7491 × 9
	2.	738 × 5	961 × 4	379 × 6	258 × 4	608 × 8	6312 × 9
II.	1.	38 × 27	54 × 39	897 × 16	361 × 91	405 × 82	4250 × 35
	2.	61 × 46	705 × 74	358 × 28	943 × 64	269 × 57	5162 × 68

		a	b	c	d	e
III.	1.	327 × 408	539 × 108	627 × 602	830 × 407	6301 × 105
	2.	289 × 403	965 × 206	476 × 507	640 × 207	6871 × 409

		a	b	c	d	e
IV.	1.	396 × 270	851 × 190	406 × 280	340 × 260	7300 × 490
	2.	814 × 760	820 × 280	709 × 650	940 × 830	2700 × 600

Answers to Multiplication of Whole Numbers

I. 1. a. 3288, b. 2187, c. 4578, d. 3176, e. 7650, f. 67,419. 2. a. 3690, b. 3844, c. 2274, d. 1032, e. 4864, f. 56,808.

II. 1. a. 1026, b. 2106, c. 14,352, d. 32,851, e. 33,210, f. 148,750. 2. a. 2806, b. 52,170, c. 10,024, d. 60,352, e. 15,333, f. 351,016.

III. 1. a. 133,416, b. 58,212, c. 377,454, d. 337,810, e. 661,605. 2. a. 116,467, b. 198,790, c. 241,332, d. 132,480, e. 2,810,239.

IV. 1. a. 106,920, b. 161,690, c. 113,680, d. 88,400, e. 3,577,000. 2. a. 618,640, b. 229,600, c. 460,850, d. 780,200, e. 1,620,000.

Division by One-Place Divisors and by Easy Two-Place Divisors

	a	b	c	d	e
I. 1.	$4\overline{)7352}$	$5\overline{)9275}$	$8\overline{)3657}$	$9\overline{)4978}$	$7\overline{)1885}$
2.	$6\overline{)8895}$	$3\overline{)8394}$	$2\overline{)9379}$	$7\overline{)5974}$	$9\overline{)8759}$
II. 1.	$3\overline{)2851}$	$5\overline{)1704}$	$4\overline{)1440}$	$6\overline{)7819}$	$8\overline{)9635}$
2.	$7\overline{)3850}$	$9\overline{)1445}$	$6\overline{)5100}$	$8\overline{)2725}$	$2\overline{)7411}$

	a	b	c	d	e
III. 1.	$9\overline{)2312}$	$6\overline{)2212}$	$7\overline{)5501}$	$4\overline{)1103}$	$8\overline{)3013}$
2.	$6\overline{)1120}$	$9\overline{)3131}$	$8\overline{)6118}$	$9\overline{)2417}$	$7\overline{)12163}$

	a	b	c	d
IV. 1.	$20\overline{)7660}$	$40\overline{)3320}$	$50\overline{)29735}$	$30\overline{)14287}$
2.	$60\overline{)97325}$	$80\overline{)36809}$	$90\overline{)42371}$	$70\overline{)58320}$

Answers to Division by One-Place Divisors and for Easy Two-Place Divisors

I. 1. a. 1838, b. 1855, c. 457r1, d. 553r1, e. 269r2. 2. a. 1482r3, b. 2798, c. 4689r1, d. 853r3, e. 973r2.

II. 1. a. 950r1, b. 340r4, c. 360, d. 1303r1, e. 1204r3. 2. a. 550, b. 160r5, c. 850, d. 340r5, e. 3705r1.

Answers to Easy Division—Continued

III. 1. a. 256r8, b. 368r4, c. 785r6, d. 275r3, e. 376r5. 2. a. 186r4, b. 347r8, c. 764r6, d. 268r5, e. 1737r4.

IV. 1. a. 383, b. 83, c. 594r35, d. 476r7. 2. a. 1622r5, b. 460r9, c. 470r71, d. 833r10.

Division with Two-or-More-Place Divisors

	a	b	c	d
I. 1.	$21\overline{)672}$	$32\overline{)745}$	$53\overline{)9699}$	$75\overline{)1764}$
2.	$36\overline{)1476}$	$94\overline{)8765}$	$86\overline{)6225}$	$64\overline{)3339}$
3.	$23\overline{)2145}$	$55\overline{)2834}$	$77\overline{)7128}$	$96\overline{)3130}$
4.	$31\overline{)1427}$	$42\overline{)1819}$	$54\overline{)5088}$	$85\overline{)7145}$
	a	b	c	d
II. 1.	$43\overline{)1316}$	$25\overline{)5025}$	$32\overline{)9710}$	$54\overline{)2160}$
2.	$51\overline{)4612}$	$33\overline{)2342}$	$58\overline{)5232}$	$67\overline{)63650}$
3.	$93\overline{)3745}$	$45\overline{)13950}$	$76\overline{)15435}$	$22\overline{)45331}$
4.	$83\overline{)17295}$	$24\overline{)9851}$	$35\overline{)17647}$	$96\overline{)88337}$
III. 1.	$24\overline{)8237}$	$37\overline{)1276}$	$48\overline{)1372}$	$56\overline{)2742}$
2.	$77\overline{)4429}$	$25\overline{)11236}$	$36\overline{)1729}$	$68\overline{)19258}$
3.	$97\overline{)28704}$	$46\overline{)30125}$	$14\overline{)4327}$	$38\overline{)3275}$
4.	$65\overline{)36402}$	$27\overline{)22128}$	$58\overline{)3346}$	$96\overline{)64321}$
IV. 1.	$27\overline{)1296}$	$38\overline{)2825}$	$48\overline{)3275}$	$36\overline{)2438}$
2.	$26\overline{)1695}$	$47\overline{)36025}$	$29\overline{)9437}$	$16\overline{)3793}$

	a	b	c	d
3.	$18\overline{)9236}$	$16\overline{)9123}$	$49\overline{)2815}$	$28\overline{)12641}$
4.	$13\overline{)8271}$	$15\overline{)8896}$	$26\overline{)1483}$	$36\overline{)27125}$
V. 1.	$216\overline{)7436}$	$324\overline{)8751}$	$934\overline{)38526}$	$425\overline{)18337}$
2.	$534\overline{)9276}$	$116\overline{)47096}$	$736\overline{)25935}$	$560\overline{)34412}$
3.	$633\overline{)9576}$	$235\overline{)24440}$	$231\overline{)78547}$	$436\overline{)23545}$
4.	$742\overline{)9661}$	$842\overline{)58965}$	$305\overline{)19561}$	$108\overline{)65232}$
VI. 1.	$365\overline{)9275}$	$481\overline{)22563}$	$576\overline{)31149}$	$673\overline{)42180}$
2.	$165\overline{)7234}$	$180\overline{)9436}$	$375\overline{)26532}$	$372\overline{)76634}$
3.	$278\overline{)8436}$	$165\overline{)10250}$	$763\overline{)36480}$	$581\overline{)43476}$
4.	$246\overline{)9357}$	$490\overline{)33468}$	$357\overline{)20450}$	$850\overline{)66300}$

Answers to Division with Two-or-More-Place Divisors

I. 1. a. 32, b. 23r9, c. 183, d. 23r39. 2. a. 41, b. 93r23, c. 72r33, d. 52r11. 3. a. 93r6, b. 51r29, c. 92r44, d. 32r58. 4. a. 46r1, b. 43r13, c. 94r12, d. 84r5.

II. 1. a. 30r26, b. 201, c. 303r14, d. 40. 2. a. 90r22, b. 70r32, c. 90r12, d. 950. 3. a. 40r25, b. 310, c. 203r7, d. 2060r11. 4. a. 208r31, b. 410r11, c. 504r7, d. 920r17.

III. 1. a. 343r5, b. 34r18, c. 28r28, d. 48r54. 2. a. 57r40, b. 449r11, c. 48r1, d. 283r14. 3. a. 295r89, b. 654r41, c. 309r1, d. 86r7. 4. a. 560r2, b. 819r15, c. 57r40, d. 670r1.

IV. 1. a. 48, b. 74r13, c. 68r11, d. 67r26. 2. a. 65r5, b. 766r23, c. 325r12, d. 237r1. 3. a. 513r2, b. 570r3, c. 57r22, d. 451r13. 4. a. 636r3, b. 593r1, c. 57r1, d. 753r17.

V. 1. a. 34r92, b. 27r3, c. 41r232, d. 43r62. 2. a. 17r198, b. 406, c. 35r175, d. 61r252. 3. a. 15r81, b. 104, c. 340r7, d. 54r1. 4. a. 13r15, b. 70r25, c. 64r41, d. 604.

VI. 1. a. 25r150, b. 46r437, c. 54r45, d. 62r454. 2. a. 43r139, b. 52r76, c. 70r282, d. 206r2. 3. a. 30r96, b. 62r20, c. 47r619, d. 74r482. 4. a. 38r9, b. 68r148, c. 57r101, d. 78.

Addition of Fractions

		a	b	c	d	e	f
I.	1.	$\frac{3}{7}$	$\frac{4}{9}$	$\frac{3}{4}$	$2\frac{1}{3}$	$6\frac{3}{5}$	$\frac{5}{6}$
		$\frac{2}{7}$	$\frac{7}{9}$	$\frac{2}{4}$	$4\frac{1}{3}$	$9\frac{4}{5}$	$4\frac{2}{6}$
	2.	$\frac{7}{10}$	$\frac{6}{8}$	$\frac{5}{9}$	$2\frac{3}{4}$	$4\frac{6}{7}$	$6\frac{7}{8}$
		$\frac{4}{10}$	$\frac{7}{8}$	$\frac{8}{9}$	$6\frac{2}{4}$	$3\frac{5}{7}$	$\frac{4}{8}$
II.	1.	$\frac{3}{8}$	$\frac{7}{12}$	$\frac{9}{16}$	$2\frac{3}{4}$	$\frac{5}{8}$	$12\frac{7}{10}$
		$\frac{1}{8}$	$\frac{11}{12}$	$\frac{13}{16}$	$6\frac{1}{4}$	$9\frac{7}{8}$	$7\frac{3}{10}$
	2.	$\frac{5}{6}$	$\frac{7}{16}$	$\frac{7}{12}$	$8\frac{3}{8}$	$2\frac{11}{16}$	$\frac{7}{9}$
		$\frac{5}{6}$	$\frac{15}{16}$	$\frac{1}{12}$	$5\frac{7}{8}$	$7\frac{9}{16}$	$4\frac{5}{9}$
III.	1.	$\frac{1}{2}$	$\frac{5}{6}$	$\frac{11}{12}$	$9\frac{5}{8}$	$7\frac{2}{3}$	$7\frac{3}{4}$
		$\frac{3}{8}$	$\frac{1}{3}$	$\frac{1}{6}$	$6\frac{3}{4}$	$8\frac{1}{6}$	$\frac{1}{8}$
	2.	$\frac{5}{9}$	$\frac{9}{10}$	$\frac{9}{16}$	$8\frac{1}{3}$	$6\frac{3}{4}$	$\frac{15}{16}$
		$\frac{2}{3}$	$\frac{1}{5}$	$\frac{3}{4}$	$5\frac{1}{12}$	$7\frac{3}{8}$	$5\frac{3}{4}$
IV.	1.	$\frac{1}{2}$	$\frac{7}{12}$	$\frac{5}{6}$	$7\frac{7}{10}$	$9\frac{3}{4}$	$6\frac{5}{6}$
		$\frac{5}{6}$	$\frac{2}{3}$	$\frac{2}{3}$	$6\frac{1}{2}$	$\frac{7}{12}$	$9\frac{5}{12}$
	2.	$\frac{3}{4}$	$\frac{5}{6}$	$\frac{3}{5}$	$6\frac{2}{3}$	$5\frac{1}{4}$	$11\frac{2}{3}$
		$\frac{11}{12}$	$\frac{11}{12}$	$\frac{9}{10}$	$8\frac{1}{12}$	$\frac{9}{20}$	$7\frac{5}{6}$
V.	1.	$\frac{1}{2}$	$\frac{3}{4}$	$\frac{1}{8}$	$5\frac{7}{8}$	$9\frac{1}{4}$	$7\frac{3}{4}$
		$\frac{2}{5}$	$\frac{2}{3}$	$\frac{2}{3}$	$6\frac{1}{3}$	$4\frac{2}{3}$	$\frac{5}{6}$
	2.	$\frac{3}{8}$	$\frac{5}{6}$	$\frac{7}{10}$	$8\frac{1}{6}$	$1\frac{3}{4}$	$16\frac{1}{2}$
		$\frac{1}{6}$	$\frac{4}{9}$	$\frac{3}{4}$	$5\frac{3}{4}$	$\frac{2}{3}$	$9\frac{4}{5}$
VI.	1.	$\frac{3}{4}$	$\frac{5}{6}$	$\frac{9}{16}$	$6\frac{2}{3}$	$8\frac{5}{6}$	$7\frac{5}{8}$
		$\frac{1}{2}$	$\frac{7}{8}$	$\frac{3}{4}$	$4\frac{1}{2}$	$3\frac{1}{2}$	$\frac{9}{16}$
		$\frac{7}{8}$	$\frac{2}{3}$	$\frac{1}{8}$	$9\frac{11}{12}$	$9\frac{3}{4}$	$8\frac{3}{4}$

2.	$\frac{1}{2}$	$\frac{11}{12}$	$\frac{7}{9}$	$7\frac{5}{8}$	$6\frac{3}{8}$	$9\frac{7}{16}$
	$\frac{2}{3}$	$\frac{3}{8}$	$\frac{2}{3}$	$9\frac{3}{4}$	$7\frac{3}{4}$	$4\frac{3}{8}$
	$\frac{3}{4}$	$\frac{5}{6}$	$\frac{1}{6}$	$4\frac{1}{2}$	$\frac{2}{3}$	$7\frac{1}{2}$

Answers to Addition of Fractions

I. 1. a. $\frac{5}{7}$, b. $1\frac{2}{3}$, c. $1\frac{1}{4}$, d. $6\frac{2}{3}$, e. $16\frac{2}{5}$, f. $5\frac{1}{6}$. 2. a. $1\frac{1}{10}$, b. $1\frac{5}{8}$, c. $1\frac{4}{9}$, d. $9\frac{1}{4}$, e. $8\frac{4}{7}$, f. $7\frac{3}{8}$.

II. 1. a. $\frac{1}{2}$, b. $1\frac{1}{2}$, c. $1\frac{3}{8}$, d. 9, e. $10\frac{1}{2}$, f. 20. 2. a. $1\frac{2}{3}$, b. $1\frac{3}{8}$, c. $\frac{2}{3}$, d. $14\frac{1}{4}$, e. $10\frac{1}{4}$, f. $5\frac{1}{3}$.

III. 1. a. $\frac{7}{8}$, b. $1\frac{1}{6}$, c. $1\frac{1}{12}$, d. $16\frac{3}{8}$, e. $15\frac{5}{6}$, f. $7\frac{7}{8}$. 2. a. $1\frac{2}{9}$, b. $1\frac{1}{10}$, c. $1\frac{5}{16}$, d. $13\frac{5}{12}$, e. $14\frac{1}{8}$, f. $6\frac{11}{16}$.

IV. 1. a. $1\frac{1}{3}$, b. $1\frac{1}{4}$, c. $1\frac{1}{2}$, d. $14\frac{2}{5}$, e. $10\frac{1}{3}$, f. $16\frac{1}{4}$. 2. a. $1\frac{2}{3}$, b. $1\frac{3}{4}$, c. $1\frac{1}{2}$, d. $14\frac{3}{4}$, e. $5\frac{7}{10}$, f. $19\frac{1}{2}$.

V. 1. a. $\frac{9}{10}$, b. $1\frac{5}{12}$, c. $\frac{19}{24}$, d. $12\frac{5}{24}$, e. $13\frac{11}{12}$, f. $8\frac{7}{12}$. 2. a. $\frac{13}{24}$, b. $1\frac{5}{18}$, c. $1\frac{9}{20}$, d. $13\frac{11}{12}$, e. $2\frac{5}{12}$, f. $26\frac{3}{10}$.

VI. 1. a. $2\frac{1}{8}$, b. $2\frac{3}{8}$, c. $1\frac{7}{16}$, d. $21\frac{1}{12}$, e. $22\frac{1}{12}$, f. $16\frac{15}{16}$. 2. a. $1\frac{11}{12}$, b. $2\frac{1}{8}$, c. $1\frac{11}{18}$, d. $21\frac{7}{8}$, e. $14\frac{19}{24}$, f. $21\frac{5}{16}$.

Subtraction of Fractions

		a	b	c	d	e	f
I.	1.	$\frac{4}{5}$	$\frac{5}{6}$	$\frac{7}{8}$	$12\frac{2}{3}$	$9\frac{5}{6}$	$9\frac{7}{12}$
		$\frac{3}{5}$	$\frac{1}{6}$	$\frac{5}{8}$	$4\frac{1}{3}$	$8\frac{5}{6}$	$6\frac{1}{12}$
	2.	$\frac{7}{9}$	$\frac{15}{16}$	$\frac{9}{10}$	$6\frac{3}{4}$	$4\frac{5}{8}$	$16\frac{4}{5}$
		$\frac{5}{9}$	$\frac{11}{16}$	$\frac{7}{10}$	$\frac{3}{4}$	$\frac{3}{8}$	$7\frac{3}{5}$
II.	1.	$\frac{3}{4}$	$\frac{1}{2}$	$\frac{9}{16}$	$12\frac{7}{8}$	$8\frac{2}{3}$	$6\frac{3}{4}$
		$\frac{7}{12}$	$\frac{3}{10}$	$\frac{1}{4}$	$6\frac{1}{2}$	$4\frac{1}{6}$	$\frac{7}{12}$
	2.	$\frac{3}{5}$	$\frac{15}{16}$	$\frac{11}{12}$	$9\frac{3}{4}$	$5\frac{3}{4}$	$8\frac{2}{3}$
		$\frac{3}{10}$	$\frac{7}{8}$	$\frac{2}{3}$	$2\frac{5}{8}$	$\frac{5}{16}$	$8\frac{5}{9}$
III.	1.	$\frac{2}{3}$	$\frac{1}{2}$	$\frac{2}{3}$	$6\frac{5}{8}$	$9\frac{3}{4}$	$1\frac{7}{8}$
		$\frac{1}{5}$	$\frac{1}{3}$	$\frac{1}{4}$	$2\frac{1}{3}$	$7\frac{2}{3}$	$\frac{2}{3}$
	2.	$\frac{5}{6}$	$\frac{5}{6}$	$\frac{2}{3}$	$8\frac{3}{4}$	$4\frac{5}{6}$	$6\frac{1}{2}$
		$\frac{3}{4}$	$\frac{3}{8}$	$\frac{2}{5}$	$1\frac{1}{6}$	$\frac{3}{8}$	$\frac{2}{5}$

Subtraction of Fractions —Continued

IV. 1.	5 $2\frac{3}{4}$	9 $1\frac{1}{6}$	8 $7\frac{1}{4}$	1 $\frac{7}{9}$	11 $8\frac{2}{3}$	16 $7\frac{4}{5}$
2.	1 $\frac{4}{9}$	3 $2\frac{2}{4}$	13 $6\frac{5}{8}$	8 $7\frac{5}{6}$	14 $5\frac{3}{8}$	17 $9\frac{3}{4}$
V. 1.	$7\frac{1}{4}$ $3\frac{3}{4}$	$5\frac{1}{8}$ $4\frac{7}{8}$	$6\frac{4}{9}$ $5\frac{7}{9}$	$1\frac{1}{8}$ $\frac{3}{8}$	$9\frac{1}{3}$ $\frac{2}{3}$	$6\frac{2}{5}$ $\frac{3}{5}$
2.	$1\frac{1}{12}$ $\frac{7}{12}$	$9\frac{1}{4}$ $8\frac{3}{4}$	$7\frac{1}{6}$ $4\frac{5}{6}$	$8\frac{1}{5}$ $\frac{4}{5}$	$10\frac{1}{9}$ $\frac{7}{9}$	$14\frac{2}{7}$ $6\frac{5}{7}$
VI. 1.	$2\frac{1}{2}$ $1\frac{3}{4}$	$5\frac{1}{4}$ $4\frac{3}{8}$	$9\frac{1}{3}$ $\frac{5}{6}$	$6\frac{1}{2}$ $\frac{7}{12}$	$10\frac{2}{3}$ $1\frac{7}{9}$	$16\frac{3}{4}$ $8\frac{7}{8}$
2.	$8\frac{1}{3}$ $1\frac{4}{6}$	$1\frac{1}{2}$ $\frac{11}{12}$	$7\frac{1}{3}$ $\frac{8}{9}$	$5\frac{1}{4}$ $\frac{11}{12}$	$10\frac{1}{5}$ $3\frac{7}{10}$	$14\frac{1}{2}$ $6\frac{9}{16}$
VII. 1.	$7\frac{1}{2}$ $1\frac{2}{3}$	$5\frac{1}{4}$ $4\frac{2}{3}$	$9\frac{1}{3}$ $7\frac{3}{4}$	$11\frac{1}{2}$ $6\frac{4}{5}$	$13\frac{1}{3}$ $7\frac{1}{2}$	$10\frac{5}{8}$ $\frac{2}{3}$
2.	$4\frac{1}{5}$ $\frac{1}{2}$	$8\frac{1}{9}$ $\frac{5}{6}$	$3\frac{1}{4}$ $\frac{5}{6}$	$14\frac{3}{4}$ $8\frac{5}{6}$	$1\frac{1}{2}$ $\frac{2}{3}$	$14\frac{1}{6}$ $5\frac{3}{4}$

Answers to Subtraction of Fractions

I. 1. a. $\frac{1}{5}$, b. $\frac{2}{3}$, c. $\frac{1}{4}$, d. $8\frac{1}{3}$, e. 1, f. $3\frac{1}{2}$. 2. a. $\frac{2}{9}$, b. $\frac{1}{4}$, c. $\frac{1}{5}$, d. 6, e. $4\frac{1}{4}$, f. $9\frac{1}{5}$.

II. 1. a. $\frac{1}{6}$, b. $\frac{1}{5}$, c. $\frac{5}{16}$, d. $6\frac{3}{8}$, e. $4\frac{1}{2}$, f. $6\frac{1}{6}$. 2. a. $\frac{3}{10}$, b. $\frac{1}{16}$, c. $\frac{1}{4}$, d. $7\frac{1}{8}$, e. $5\frac{7}{16}$, f. $\frac{1}{9}$.

III. 1. a. $\frac{7}{15}$, b. $\frac{1}{6}$, c. $\frac{5}{12}$, d. $4\frac{7}{24}$, e. $2\frac{1}{12}$, f. $1\frac{5}{24}$. 2. a. $\frac{1}{12}$, b. $\frac{11}{24}$, c. $\frac{4}{15}$, d. $7\frac{7}{12}$, e. $4\frac{11}{24}$, f. $6\frac{1}{10}$.

IV. 1. a. $2\frac{1}{4}$, b. $7\frac{5}{6}$, c. $\frac{3}{4}$, d. $\frac{2}{9}$, e. $2\frac{1}{3}$, f. $8\frac{1}{5}$. 2. a. $\frac{5}{9}$, b. $\frac{1}{2}$, c. $6\frac{3}{8}$, d. $\frac{1}{6}$, e. $8\frac{5}{8}$, f. $7\frac{1}{4}$.

V. 1. a. $3\frac{1}{2}$, b. $\frac{1}{4}$, c. $\frac{2}{3}$, d. $\frac{3}{4}$, e. $8\frac{2}{3}$, f. $5\frac{4}{5}$. 2. a. $\frac{1}{2}$, b. $\frac{1}{2}$, c. $2\frac{1}{3}$, d. $7\frac{2}{5}$, e. $9\frac{1}{3}$, f. $7\frac{4}{7}$.

VI. 1. a. $\frac{3}{4}$, b. $\frac{7}{8}$, c. $8\frac{1}{2}$, d. $5\frac{11}{12}$, e. $8\frac{8}{9}$, f. $7\frac{7}{8}$. 2. a. $6\frac{2}{3}$, b. $\frac{7}{12}$, c. $6\frac{4}{9}$, d. $4\frac{1}{3}$, e. $6\frac{1}{2}$, f. $7\frac{15}{16}$.

VII. 1. a. $5\frac{5}{6}$, b. $\frac{7}{12}$, c. $1\frac{7}{12}$, d. $4\frac{7}{10}$, e. $5\frac{5}{6}$, f. $9\frac{23}{24}$. 2. a. $3\frac{7}{10}$, b. $7\frac{5}{18}$, c. $2\frac{5}{12}$, d. $5\frac{11}{12}$, e. $\frac{5}{6}$, f. $8\frac{5}{12}$.

Multiplication of Fractions

	a	b	c	d	e
I. 1.	$5 \times \frac{1}{8}$	$6 \times \frac{3}{4}$	$7 \times \frac{1}{12}$	$9 \times \frac{3}{4}$	$6 \times \frac{1}{2}$
2.	$8 \times \frac{3}{4}$	$12 \times \frac{5}{6}$	$8 \times \frac{2}{3}$	$5 \times \frac{5}{6}$	$7 \times \frac{2}{3}$
3.	$4 \times \frac{5}{9}$	$9 \times \frac{3}{8}$	$12 \times \frac{11}{12}$	$16 \times \frac{5}{8}$	$24 \times \frac{5}{6}$
II. 1.	$\frac{4}{5} \times 10$	$\frac{9}{10} \times 30$	$\frac{7}{8} \times 2$	$\frac{5}{6} \times 9$	$\frac{11}{12} \times 4$
2.	$\frac{2}{3} \times 8$	$\frac{5}{6} \times 12$	$\frac{5}{12} \times 20$	$\frac{3}{4} \times 15$	$\frac{3}{8} \times 24$
3.	$\frac{3}{5} \times 6$	$\frac{1}{2} \times 7$	$\frac{1}{8} \times 6$	$\frac{2}{5} \times 12$	$\frac{3}{7} \times 8$
III. 1.	$\frac{1}{2} \times \frac{1}{4}$	$\frac{3}{4} \times \frac{5}{8}$	$\frac{1}{3} \times \frac{4}{5}$	$\frac{2}{3} \times \frac{4}{9}$	$\frac{5}{6} \times \frac{1}{3}$
2.	$\frac{3}{4} \times \frac{5}{6}$	$\frac{7}{8} \times \frac{2}{9}$	$\frac{2}{3} \times \frac{5}{6}$	$\frac{4}{5} \times \frac{9}{10}$	$\frac{5}{8} \times \frac{7}{10}$
3.	$\frac{2}{3} \times \frac{3}{8}$	$\frac{3}{8} \times \frac{4}{15}$	$\frac{7}{9} \times \frac{3}{14}$	$\frac{2}{5} \times \frac{15}{16}$	$\frac{4}{9} \times \frac{9}{10}$
IV. 1.	$\frac{2}{3} \times 1\frac{1}{2}$	$\frac{1}{2} \times 3\frac{1}{4}$	$\frac{4}{5} \times 2\frac{1}{2}$	$2\frac{1}{4} \times \frac{3}{4}$	$\frac{2}{3} \times 3\frac{1}{3}$
2.	$\frac{5}{6} \times 2\frac{1}{4}$	$2\frac{1}{3} \times \frac{3}{7}$	$\frac{4}{5} \times 1\frac{2}{3}$	$\frac{8}{9} \times 2\frac{1}{2}$	$\frac{4}{7} \times 2\frac{1}{3}$
3.	$4\frac{1}{2} \times 6\frac{2}{3}$	$\frac{3}{4} \times 5\frac{1}{2}$	$\frac{3}{4} \times 2\frac{2}{3}$	$1\frac{1}{4} \times \frac{4}{5}$	$3\frac{1}{3} \times \frac{3}{5}$
V. 1.	$27 \times 4\frac{2}{3}$	$36 \times 9\frac{3}{4}$	$51 \times 8\frac{1}{3}$	$14 \times 2\frac{3}{7}$	$35 \times 7\frac{4}{5}$
2.	$41\frac{1}{2} \times 5$	$36\frac{3}{4} \times 7$	$65\frac{1}{2} \times 8$	$87\frac{1}{2} \times 6$	$44\frac{2}{3} \times 9$
3.	$38 \times 4\frac{3}{4}$	$45\frac{3}{4} \times 9$	$67\frac{1}{2} \times 8$	$83 \times 6\frac{5}{8}$	$92 \times 6\frac{2}{3}$

	a	b	c	d
VI. 1.	$4 \times \frac{2}{3} \times \frac{5}{6}$	$\frac{1}{2} \times \frac{3}{4} \times \frac{8}{9}$	$\frac{4}{5} \times \frac{2}{3} \times \frac{7}{8}$	$\frac{9}{10} \times \frac{2}{3} \times \frac{5}{8}$
2.	$1\frac{1}{2} \times \frac{3}{4} \times 2\frac{1}{2}$	$\frac{5}{6} \times \frac{3}{4} \times 2\frac{3}{4}$	$8 \times \frac{5}{6} \times 1\frac{1}{4}$	$9 \times \frac{3}{4} \times \frac{6}{7}$
3.	$2\frac{1}{4} \times 3\frac{1}{2} \times 1\frac{1}{3}$	$1\frac{1}{8} \times 1\frac{3}{4} \times 2\frac{2}{7}$	$\frac{3}{4} \times \frac{8}{9} \times 2\frac{1}{3}$	$3\frac{1}{3} \times 1\frac{1}{2} \times \frac{4}{5}$

Answers to Multiplication of Fractions

I. 1. a. $\frac{5}{8}$, b. $4\frac{1}{2}$, c. $\frac{7}{12}$, d. $6\frac{3}{4}$, e. 3. 2. a. 6, b. 10, c. $5\frac{1}{3}$, d. $4\frac{1}{6}$, e. $4\frac{2}{3}$. 3. a. $2\frac{2}{9}$, b. $3\frac{3}{8}$, c. 11, d. 10, e. 20.

II. 1. a. 8, b. 27, c. $1\frac{3}{4}$, d. $7\frac{1}{2}$, e. $3\frac{2}{3}$. 2. a. $5\frac{1}{3}$, b. 10, c. $8\frac{1}{3}$, d. $11\frac{1}{4}$, e. 9. 3. a. $3\frac{3}{5}$, b. $3\frac{1}{2}$, c. $\frac{3}{4}$, d. $4\frac{4}{5}$, e. $3\frac{3}{7}$.

III. 1. a. $\frac{1}{8}$, b. $\frac{15}{32}$, c. $\frac{4}{15}$, d. $\frac{8}{27}$, e. $\frac{5}{18}$. 2. a. $\frac{5}{8}$, b. $\frac{7}{36}$, c. $\frac{5}{9}$, d. $\frac{18}{25}$, e. $\frac{7}{16}$. 3. a. $\frac{1}{4}$, b. $\frac{1}{10}$, c. $\frac{1}{6}$, d. $\frac{3}{8}$, e. $\frac{2}{5}$.

IV. 1. a. 1, b. $1\frac{5}{8}$, c. 2, d. $1\frac{11}{16}$, e. $2\frac{2}{9}$. 2. a. $1\frac{7}{8}$, b. 1, c. $1\frac{1}{3}$, d. $2\frac{2}{9}$, e. $1\frac{1}{3}$. 3. a. 30, b. $4\frac{1}{8}$, c. 2, d. 1, e. 2.

V. 1. a. 126, b. 351, c. 425, d. 34, e. 273. 2. a. $207\frac{1}{2}$, b. $257\frac{1}{4}$, c. 524, d. 525, e. 402. 3. a. $180\frac{1}{2}$, b. $411\frac{3}{4}$, c. 540, d. $549\frac{7}{8}$, e. $613\frac{1}{3}$.

VI. 1. a. $2\frac{2}{9}$, b. $\frac{1}{3}$, c. $\frac{7}{15}$, d. $\frac{3}{8}$. 2. a. $2\frac{13}{16}$, b. $1\frac{23}{32}$, c. $8\frac{1}{3}$, d. $5\frac{11}{14}$. 3. a. $10\frac{1}{2}$, b. $4\frac{1}{2}$, c. $1\frac{5}{9}$, d. 4.

Division of Fractions

	a	b	c	d	e
I. 1.	$12 \div \frac{3}{4}$	$24 \div \frac{3}{8}$	$55 \div \frac{5}{6}$	$64 \div \frac{8}{9}$	$30 \div \frac{3}{4}$
2.	$18 \div \frac{4}{5}$	$35 \div \frac{2}{3}$	$15 \div \frac{6}{7}$	$12 \div \frac{5}{8}$	$14 \div \frac{5}{9}$
3.	$16 \div \frac{1}{3}$	$27 \div \frac{3}{5}$	$11 \div \frac{3}{4}$	$40 \div \frac{5}{8}$	$72 \div \frac{8}{9}$
II. 1.	$\frac{2}{3} \div \frac{2}{5}$	$\frac{3}{4} \div \frac{3}{8}$	$\frac{5}{6} \div \frac{1}{2}$	$\frac{7}{8} \div \frac{3}{4}$	$\frac{5}{6} \div \frac{5}{8}$
2.	$\frac{1}{2} \div \frac{3}{4}$	$\frac{5}{8} \div \frac{9}{10}$	$\frac{9}{10} \div \frac{5}{8}$	$\frac{3}{4} \div \frac{11}{12}$	$\frac{11}{12} \div \frac{3}{4}$
3.	$\frac{5}{6} \div \frac{4}{9}$	$\frac{1}{2} \div \frac{2}{3}$	$\frac{3}{4} \div \frac{1}{2}$	$\frac{7}{8} \div \frac{2}{3}$	$\frac{9}{16} \div \frac{3}{4}$
III. 1.	$\frac{5}{6} \div 2$	$\frac{3}{4} \div 3$	$\frac{7}{8} \div 4$	$\frac{11}{12} \div 3$	$\frac{5}{6} \div 5$
2.	$\frac{6}{7} \div 3$	$\frac{15}{16} \div 5$	$\frac{4}{7} \div 8$	$\frac{9}{10} \div 6$	$\frac{9}{16} \div 6$
3.	$\frac{2}{3} \div 8$	$\frac{7}{8} \div 7$	$\frac{1}{4} \div 3$	$\frac{1}{2} \div 8$	$\frac{5}{12} \div 5$
IV. 1.	$1\frac{1}{2} \div 3$	$2\frac{1}{4} \div 5$	$1\frac{1}{3} \div 4$	$2\frac{1}{2} \div 5$	$7\frac{1}{2} \div 3$
2.	$6 \div 1\frac{1}{2}$	$7 \div 2\frac{1}{3}$	$8 \div 1\frac{1}{3}$	$12 \div 5\frac{1}{3}$	$4 \div 1\frac{1}{2}$
3.	$1 \div 2\frac{1}{2}$	$2\frac{1}{2} \div 2$	$5\frac{1}{3} \div 8$	$4 \div 1\frac{1}{3}$	$1\frac{1}{3} \div 4$
V. 1.	$2\frac{1}{2} \div 1\frac{1}{4}$	$1\frac{1}{4} \div 2\frac{1}{2}$	$2\frac{1}{2} \div 1\frac{1}{3}$	$5\frac{1}{3} \div 2\frac{2}{5}$	$1\frac{1}{2} \div 4\frac{1}{4}$
2.	$\frac{5}{6} \div 1\frac{1}{4}$	$1\frac{1}{4} \div \frac{5}{6}$	$\frac{2}{3} \div 3\frac{1}{5}$	$3\frac{1}{5} \div \frac{2}{3}$	$\frac{9}{10} \div 2\frac{1}{2}$
3.	$3\frac{1}{3} \div 4\frac{1}{6}$	$4\frac{1}{6} \div 3\frac{1}{3}$	$1\frac{2}{3} \div 6\frac{2}{3}$	$6\frac{2}{3} \div 1\frac{2}{3}$	$1\frac{1}{4} \div 3\frac{1}{4}$
VI. 1.	$4 \div 9$	$5 \div 8$	$11 \div 12$	$6 \div 7$	$7 \div 12$
2.	$6 \div 9$	$12 \div 15$	$14 \div 16$	$24 \div 36$	$17 \div 51$

Answers to Division of Fractions

I. 1. a. 16, b. 64, c. 66, d. 72, e. 40. 2. a. $22\frac{1}{2}$, b. $52\frac{1}{2}$, c. $17\frac{1}{2}$, d. $19\frac{1}{5}$, e. $25\frac{1}{5}$. 3. a. 48, b. 45, c. $14\frac{2}{3}$, d. 64, e. 81.

II. 1. a. $1\frac{2}{3}$, b. 2, c. $1\frac{2}{3}$, d. $1\frac{1}{6}$, e. $1\frac{1}{3}$. 2. a. $\frac{2}{3}$, b. $\frac{25}{36}$, c. $1\frac{11}{25}$, d. $\frac{9}{11}$, e. $1\frac{2}{9}$. 3. a. $1\frac{7}{8}$, b. $\frac{3}{4}$, c. $1\frac{1}{2}$, d. $1\frac{5}{16}$, e. $\frac{3}{4}$.

III. 1. a. $\frac{5}{12}$, b. $\frac{1}{4}$, c. $\frac{7}{32}$, d. $\frac{11}{36}$, e. $\frac{1}{6}$. 2. a. $\frac{2}{7}$, b. $\frac{3}{16}$, c. $\frac{1}{14}$, d. $\frac{3}{20}$, e. $\frac{3}{32}$. 3. a. $\frac{1}{12}$, b. $\frac{1}{8}$, c. $\frac{1}{12}$, d. $\frac{1}{16}$, e. $\frac{1}{12}$.

IV. 1. a. $\frac{1}{2}$, b. $\frac{9}{20}$, c. $\frac{1}{3}$, d. $\frac{1}{2}$, e. $2\frac{1}{2}$. 2. a. 4, b. 3, c. 6, d. $2\frac{1}{4}$, e. $2\frac{2}{3}$. 3. a. $\frac{2}{5}$, b. $1\frac{1}{4}$, c. $\frac{2}{3}$, d. 3, e. $\frac{1}{3}$.

V. 1. a. 2, b. $\frac{1}{2}$, c. $1\frac{7}{8}$, d. $2\frac{2}{9}$, e. $\frac{6}{17}$. 2. a. $\frac{2}{3}$, b. $1\frac{1}{2}$, c. $\frac{5}{24}$, d. $4\frac{4}{5}$, e. $\frac{9}{25}$. 3. a. $\frac{4}{5}$, b. $1\frac{1}{4}$, c. $\frac{1}{4}$, d. 4, e. $\frac{5}{13}$.

VI. 1. a. $\frac{4}{9}$, b. $\frac{5}{8}$, c. $\frac{11}{12}$, d. $\frac{6}{7}$, e. $\frac{7}{12}$. 2. a. $\frac{2}{3}$, b. $\frac{4}{5}$, c. $\frac{7}{8}$, d. $\frac{2}{3}$, e. $\frac{1}{3}$.

Addition of Decimals

I. a	b	c	d	e	f	g
.6	.3	.3	.43	3.4	7.6	2.98
.8	.9	.2	.58	2.8	3.9	1.56
.3	.7	.8	.26	9.6	8.5	9.73
.9	.6	.7	.19	5.1	1.7	4.57

II. a	b	c	d	e
.735	.850	.375	4.356	9.250
.456	.935	.288	9.285	8.375
.928	.678	.563	6.143	6.468
.167	.144	.749	0.125	3.725

III. a	b	c	d	e	f
.05	.01	.025	.406	.750	.640
.09	.09	.037	.305	.360	.320
.06	.07	.046	.708	.850	.980
.04	.03	.082	.609	.970	.760

	a	b	c	d	e	f
IV. 1.	3.2	1.75	.925	3.5	.04	6.7
	1.45	0.93	.48	1.8	.35	4.3
	3.85	0.8	.37	2.25	.725	5.8
	9.6	4.56	.45	4.78	.93	7.75

Addition of Decimals—Continued

Copy and add.

2. a. $4.8 + 3.6 + 2.55 + .9$ b. $.075 + .225 + .38 + .94$
3. a. $5.6 + 1.25 + 3.84 + 1.6$ b. $.95 + .475 + .328 + .451$

Answers to Addition of Decimals

I. a. 2.6, b. 2.5, c. 2.0, d. 1.46, e. 20.9, f. 21.7, g. 18.84.
II. a. 2.286, b. 2.607, c. 1.975, d. 19.909, e. 27.818.
III. a. .24, b. .20, c. .190, d. 2.028, e. 2.930, f. 2.700.
IV. 1. a. 18.1, b. 8.04, c. 2.225, d. 12.33, e. 2.045, f. 24.55. 2. a. 11.85, b. 1.62. 3. a. 12.29, b. 2.204.

Subtraction of Decimals

	a	b	c	d	e	f
I. 1.	.48	.76	3.41	7.25	6.10	9.47
	.35	.58	1.08	4.57	3.54	8.65
2.	.9	.62	8.27	9.04	8.12	4.23
	.4	.34	5.46	7.42	5.38	1.57

	a	b	c	d	e
II. 1.	.946	.765	.467	8.740	4.075
	.325	.238	.198	5.365	2.348
2.	.675	.625	.470	9.162	6.420
	.348	.186	.285	3.855	1.055
III. 1.	.325	.716	.523	.025	.031
	.284	.650	.475	.018	.012
2.	.910	.375	.061	.075	.018
	.856	.295	.053	.068	.009

IV. 1.	5.8	7	1.45	3.6	9.1
	2.36	3.45	.98	2.44	4.32
2.	5	11.4	9.5	1.56	7.4
	2.38	3.68	.37	.87	5.94

Answers to Subtraction of Decimals

I. 1. a. .13, **b.** .18, **c.** 2.33, **d.** 2.68, **e.** 2.56, **f.** .82. **2. a.** .5, **b.** .28, **c.** 2.81, **d.** 1.62, **e.** 2.74, **f.** 2.66.

II. 1. a. .621, **b.** .527, **c.** .269, **d.** 3.375, **e.** 1.727. **2. a.** .327, **b.** .439, **c.** .185, **d.** 5.307, **e.** 5.365.

III. 1. a. .041, **b.** .066, **c.** .048, **d.** .007, **e.** .019. **2. a.** .054, **b.** .080, **c.** .008, **d.** .007, **e.** .009.

IV. 1. a. 3.44, **b.** 3.55, **c.** .47, **d.** 1.16, **e.** 4.78. **2. a.** 2.62, **b.** 7.72, **c.** 9.13, **d.** .69, **e.** 1.46.

Multiplication of Decimals

	a	b	c	d	e	f
I. 1.	.47	3.68	7.25	57.6	97.3	48.6
	×3	×7	×9	×4	×2	×8
2.	.79	.842	.349	.671	8.45	30.7
	×5	×6	×8	×5	×7	×4
II. 1.	56	37	524	625	295	731
	×.7	×.8	×.3	×.4	×.8	×.9
2.	46	75	102	396	425	675
	×1.8	×4.5	×3.7	×2.6	×.09	×.04
III. 1.	4.5	5.8	9.2	3.7	.98	6.4
	×2.4	×.36	×1.8	×.25	×.15	×5.3
2.	.72	10.8	32.5	5.9	43.6	7.26
	×.35	×3.4	×.46	×1.2	×.75	×9.5

Multiplication of Decimals—Continued

IV. 1.

.2	.25	.16	.37	.58	.395
×.4	×.3	×.5	×.06	×.15	×.1

2.

.19	.83	.75	.93	.675	.348
×.5	×.06	×.12	×.07	×.14	×.15

V. 1. Multiply each of the following by 100:

a. 7.6 **b.** 9.3 **c.** .765 **d.** 84.5 **e.** 53.7 **f.** .125

2. Multiply each of the following by 1000:

a. .4 **b.** 1.6 **c.** .075 **d.** 3.45 **e.** 9.56 **f.** 1.175

Answers to Multiplication of Decimals

I. 1. **a.** 1.41, **b.** 25.76, **c.** 65.25, **d.** 230.4, **e.** 194.6, **f.** 388.8. 2. **a.** 3.95, **b.** 5.052, **c.** 2.792, **d.** 3.355, **e.** 59.15, **f.** 122.8.

II. 1. **a.** 39.2, **b.** 29.6, **c.** 157.2, **d.** 250, **e.** 236, **f.** 657.9. 2. **a.** 82.8, **b.** 337.5, **c.** 377.4, **d.** 1029.6, **e.** 38.25, **f.** 27.

III. 1. **a.** 10.8, **b.** 2.088, **c.** 16.56, **d.** .925, **e.** .147. **f.** 33.92. 2. **a.** .252, **b.** 36.72, **c.** 14.95, **d.** 7.08, **e.** 32.7, **f.** 68.97.

IV. 1. **a.** .08, **b.** .075, **c.** .08, **d.** .0222, **e.** .087, **f.** .0395. 2. **a.** .095, **b.** .0498, **c.** .09, **d.** .0651, **e.** .0945, **f.** .0522.

V. 1. **a.** 760, **b.** 930, **c.** 76.5, **d.** 8450, **e.** 5370, **f.** 12.5. 2. **a.** 400, **b.** 1600, **c.** 75, **d.** 3450, **e.** 9560, **f.** 1175.

Division of Decimals

	a	b	c	d	e
I. 1.	$4\overline{).64}$	$5\overline{)7.5}$	$9\overline{)3.6}$	$7\overline{)20.3}$	$8\overline{)1.24}$
2.	$3\overline{).75}$	$2\overline{)9.7}$	$5\overline{)7.3}$	$4\overline{).66}$	$6\overline{)6.3}$
3.	$8\overline{)4.5}$	$5\overline{)3.8}$	$7\overline{)24.5}$	$12\overline{)9.6}$	$16\overline{)4.4}$
II. 1.	$3\overline{).27}$	$5\overline{).12}$	$8\overline{).12}$	$9\overline{).45}$	$6\overline{).3}$
2.	$2\overline{).1}$	$4\overline{).14}$	$6\overline{).48}$	$8\overline{).36}$	$9\overline{).54}$
3.	$12\overline{).9}$	$16\overline{).4}$	$20\overline{).14}$	$25\overline{)1.2}$	$50\overline{)3.8}$

III. 1. $4\overline{)7}$ $5\overline{)3}$ $8\overline{)14}$ $12\overline{)15}$ $6\overline{)9}$

2. $2\overline{)11}$ $16\overline{)7}$ $20\overline{)3}$ $25\overline{)31}$ $50\overline{)11}$

3. $4\overline{)31}$ $6\overline{)39}$ $16\overline{)21}$ $18\overline{)45}$ $24\overline{)78}$

IV. 1. $.2\overline{)7}$ $.5\overline{)11}$ $.7\overline{)56}$ $.8\overline{)14}$ $.4\overline{)33}$

2. $.5\overline{)37}$ $.9\overline{)486}$ $1.6\overline{)84}$ $.03\overline{)72}$ $2.5\overline{)67}$

3. $.16\overline{)54}$ $.02\overline{)19}$ $.25\overline{)6}$ $1.5\overline{)12}$ $.24\overline{)168}$

V. 1. $.3\overline{).81}$ $.5\overline{)9.6}$ $.8\overline{).12}$ $.6\overline{).15}$ $.9\overline{)5.13}$

2. $.04\overline{).34}$ $1.6\overline{).78}$ $1.2\overline{).18}$ $.75\overline{).6}$ $.25\overline{)3.1}$

3. $.08\overline{)1.2}$ $.14\overline{).7}$ $.36\overline{)1.44}$ $.15\overline{)2.1}$ $.24\overline{)51.6}$

VI. 1. $3\overline{)2}$ $9\overline{)7}$ $6\overline{)11}$ $7\overline{)15}$ $3\overline{)17}$

2. $11\overline{)5}$ $15\overline{)8}$ $13\overline{)29}$ $6\overline{)50}$ $7\overline{)55}$

3. $14\overline{)3}$ $17\overline{)21}$ $11\overline{)9}$ $21\overline{)90}$ $24\overline{)1}$

Answers to Division of Decimals

I. 1. a. .16, b. 1.5, c. .4, d. 2.9, e. .155. 2. a. .25, b. 4.85, c. 1.46, d. .165, e. 1.05. 3. a. .5625, b. .76, c. 3.5, d. .8, e. .275.

II. 1. a. .09, b. .024, c. .015, d. .05, e. .05. 2. a. .05, b. .035, c. .08, d. .045, e. .06. 3. a. .075, b. .025, c. .007, d. .048, e. .076.

III. 1. a. 1.75, b. .6, c. 1.75, d. 1.25, e. 1.5. 2. a. 5.5, b. .4375, c. .15, d. 1.24, e. .22. 3. a. 7.75, b. 6.5, c. 1.3125, d. 2.5, e. 3.25.

IV. 1. a. 35, b. 22, c. 80, d. 17.5, e. 82.5. 2. a. 74, b. 540, c. 52.5, d. 2400, e. 26.8. 3. a. 337.5, b. 950, c. 24, d. 8, e. 700.

V. 1. a. 2.7, b. 19.2, c. .15, d. .25, e. 5.7. 2. a. 8.5, b. .4875, c. .15, d. .8, e. 12.4. 3. a. 15, b. 5, c. 4, d. 14, e. 215.

VI. 1. a. .67, b. .78, c. 1.83, d. 2.14, e. 5.67. 2. a. .45, b. .53, c. 2.23, d. 8.33, e. 7.86. 3. a. .21, b. 1.24, c. .82, d. 4.29, e. .04.

Per Cents

I. Express each of the following as a decimal fraction:

	a	b	c	d	e	f	g
1.	40%	35%	125%	200%	5%	150%	8%
2.	600%	1.5%	2.25%	1.3%	6%	16%	50%

II. Express each of the following as a per cent:

1.	.5	.12	3	2.8	.28	.015	.4
2.	.07	1.3	2.25	.56	1.75	2.6	.034

III. Express each of the following as a common fraction:

1.	50%	25%	40%	10%	75%	$66\frac{2}{3}\%$	5%
2.	$62\frac{1}{2}\%$	$3\frac{1}{3}\%$	90%	$16\frac{2}{3}\%$	$12\frac{1}{2}\%$	$87\frac{1}{2}\%$	45%

IV. Express each of the following as a per cent:

1.	$\frac{1}{4}$	$\frac{3}{4}$	$\frac{2}{5}$	$\frac{4}{5}$	$\frac{5}{8}$	$\frac{3}{8}$	$\frac{7}{8}$
2.	$\frac{1}{8}$	$\frac{1}{5}$	$\frac{1}{6}$	$\frac{5}{6}$	$\frac{3}{5}$	$\frac{1}{20}$	$\frac{7}{20}$

	a	b	c	d
V. 1.	5% of 70	16% of 40	25% of 72	$33\frac{1}{3}\%$ of 144
2.	15% of 140	3.5% of 96	1.5% of 460	2.5% of 84
3.	120% of 68	2.4% of 340	200% of 78	300% of 460
4.	$\frac{1}{2}\%$ of 740	1.2% of 750	$\frac{1}{4}\%$ of 1420	250% of 36
5.	2% of 76	140% of 380	300% of 56	4.2% of 1450

VI. 1.	4 = ?% of 12	7 = ?% of 20	9 = ?% of 25	11 = ?% of 50
2.	7 = ?% of 5	20 = ?% of 8	16 = ?% of 12	37 = ?% of 25
3.	100 = ?% of 60	60 = ?% of 50	20 = ?% of 25	25 = ?% of 20
4.	1 = ?% of 50	70 = ?% of 50	4 = ?% of 60	5 = ?% of 3
5.	45 = ?% of 40	6 = ?% of 30	8 = ?% of 6	3 = ?% of 60

	a	b	c
VII.	1. $3 = 1\%$ of ?	$5 = 2\%$ of ?	$60 = 10\%$ of ?
	2. $8 = 5\%$ of ?	$20 = 200\%$ of ?	$50 = 40\%$ of ?
	3. $7 = 100\%$ of ?	$15 = 200\%$ of ?	$8 = 40\%$ of ?
	4. $100 = 33\frac{1}{3}\%$ of ?	$25 = 5\%$ of ?	$75 = 15\%$ of ?
	5. $75 = 5\%$ of ?	$14 = 200\%$ of ?	$50 = 20\%$ of ?
	6. $90 = 300\%$ of ?	$60 = 150\%$ of ?	$120 = 300\%$ of ?
	7. $64 = 40\%$ of ?	$30 = 25\%$ of ?	$150 = 75\%$ of ?

Answers to Per Cents

I. 1. a. .4, b. .35, c. 1.25, d. 2, e. .05, f. 1.5, g. .08. 2. a. 6, b. .015, c. .0225, d. .013, e. .06, f. .16, g. .5.

II. 1. a. 50%, b. 12%, c. 300%, d. 280%, e. 28%, f. 1.5%, g. 40%. 2. a. 7%, b. 130%, c. 225%, d. 56%, e. 175%, f. 260%, g. 3.4%.

III. 1. a. $\frac{1}{2}$, b. $\frac{1}{4}$, c. $\frac{2}{5}$, d. $\frac{1}{10}$, e. $\frac{3}{4}$, f. $\frac{2}{3}$, g. $\frac{1}{20}$. 2. a. $\frac{5}{8}$, b. $\frac{1}{30}$, c. $\frac{9}{10}$, d. $\frac{1}{6}$, e. $\frac{1}{8}$, f. $\frac{7}{8}$, g. $\frac{9}{20}$.

IV. 1. a. 25%, b. 75%, c. 40%, d. 80%, e. $62\frac{1}{2}\%$, f. $37\frac{1}{2}\%$, g. $87\frac{1}{2}\%$. 2. a. $12\frac{1}{2}\%$, b. 20%, c. $16\frac{2}{3}\%$, d. $83\frac{1}{3}\%$, e. 60%, f. 5%, g. 35%.

V. 1. a. 3.5, b. 6.4, c. 18, d. 48. 2. a. 21, b. 3.36, c. 6.9, d. 2.1. 3. a. 81.6, b. 8.16, c. 156, d. 1380. 4. a. 3.7, b. 9, c. 3.55, d. 90. 5. a. 1.52, b. 532, c. 168, d. 60.9.

VI. 1. a. $33\frac{1}{3}\%$, b. 35%, c. 36%, d. 22%. 2. a. 140%, b. 250%, c. $133\frac{1}{3}\%$, d. 148%. 3. a. $166\frac{2}{3}\%$, b. 120%, c. 80%, d. 125%. 4. a. 2%, b. 140%, c. $6\frac{2}{3}\%$, d. $166\frac{2}{3}\%$. 5. a. 112.5%, b. 20%, c. $133\frac{1}{3}\%$, d. 5%.

VII. 1. a. 300, b. 250, c. 600. 2. a. 160, b. 10, c. 125. 3. a. 7, b. 7.5, c. 20. 4. a. 300, b. 500, c. 500. 5. a. 1500, b. 7, c. 250. 6. a. 30, b. 40, c. 40. 7. a. 160, b. 120, c. 200.

One-Place Divisors and Easy Two-Place Divisors

14

	a	b	c	d	e
1.	4)7352	5)9754	6)13254	8)48125	20)9640
2.	7)3124	8)6052	9)3371	3)2127	30)14682
3.	5)4263	6)29143	7)60120	9)4112	60)31254
4.	9)40125	7)5044	8)3728	6)4014	70)61230
5.	80)9640	90)75231	40)9010	50)3072	60)9000

Two-or-More-Place Divisors

16

	a	b	c	d
1.	36)1476	24)9613	54)3795	410)24617
2.	85)72365	54)10962	76)72321	514)37215
3.	27)8120	38)9246	58)3017	261)21379
4.	45)18213	67)43125	88)57100	125)42125
5.	27)82140	59)16257	65)13125	364)19275
6.	74)22185	28)19167	47)33489	275)18460
7.	35)14020	29)84361	67)45382	902)841739
8.	16)8050	14)7234	15)6947	136)725407

Rounding Off the Quotient

Round off the quotient to the nearest whole number.

18

	a	b	c	d	e
1.	12)835	16)9145	27)1856	57)1431	76)1439
2.	18)856	31)7142	59)1326	98)7431	66)1796
3.	25)7394	58)6139	47)1930	74)4394	85)6192
4.	15)4891	23)7450	93)5108	48)4030	17)6324

Addition of Fractions

22

	a	b	c	d	e	f	g
1.	$\frac{7}{8}$	$\frac{5}{6}$	$\frac{4}{9}$	$8\frac{1}{4}$	$9\frac{1}{3}$	$2\frac{3}{4}$	$\frac{9}{16}$
	$\frac{1}{2}$	$\frac{2}{3}$	$\frac{1}{3}$	$7\frac{1}{12}$	$8\frac{5}{6}$	$\frac{7}{8}$	$\frac{3}{8}$
2.	$\frac{1}{2}$	$\frac{3}{4}$	$\frac{7}{12}$	$1\frac{1}{5}$	$5\frac{3}{4}$	$9\frac{3}{4}$	$1\frac{2}{3}$
	$\frac{2}{3}$	$\frac{5}{6}$	$\frac{3}{8}$	$7\frac{9}{10}$	$8\frac{1}{6}$	$\frac{7}{12}$	$4\frac{8}{9}$
3.	4	$8\frac{1}{4}$	$\frac{5}{6}$	$1\frac{1}{3}$	$4\frac{7}{9}$	$11\frac{1}{2}$	$4\frac{3}{4}$
	$1\frac{3}{8}$	$1\frac{2}{3}$	$2\frac{7}{12}$	$2\frac{5}{8}$	$\frac{5}{6}$	$\frac{3}{5}$	$7\frac{9}{10}$
4.	$\frac{2}{3}$	$\frac{7}{8}$	$\frac{1}{3}$	$\frac{11}{12}$	$9\frac{1}{2}$	$4\frac{2}{3}$	$3\frac{1}{3}$
	$\frac{5}{6}$	$\frac{3}{4}$	$\frac{2}{5}$	$\frac{5}{8}$	$2\frac{5}{6}$	$1\frac{5}{8}$	$8\frac{5}{6}$
	$\frac{1}{2}$	$\frac{9}{16}$	$\frac{7}{10}$	$\frac{1}{6}$	$4\frac{2}{3}$	$\frac{11}{12}$	$1\frac{11}{12}$
5.	$\frac{3}{4}$	$\frac{11}{12}$	$\frac{1}{2}$	$8\frac{2}{3}$	$4\frac{5}{6}$	$7\frac{2}{3}$	$2\frac{3}{4}$
	$\frac{1}{8}$	$\frac{3}{4}$	$\frac{4}{5}$	$9\frac{1}{4}$	9	$1\frac{5}{8}$	$14\frac{1}{3}$
	$\frac{5}{6}$	$\frac{2}{3}$	$\frac{7}{10}$	$1\frac{7}{8}$	$7\frac{3}{4}$	$9\frac{3}{4}$	$5\frac{1}{2}$

Subtraction of Fractions

25

	a	b	c	d	e	f	g
1.	$\frac{5}{8}$	$\frac{2}{3}$	$\frac{5}{6}$	$7\frac{1}{2}$	$2\frac{5}{8}$	$7\frac{1}{3}$	$1\frac{1}{3}$
	$\frac{1}{4}$	$\frac{1}{12}$	$\frac{2}{3}$	$1\frac{1}{4}$	$2\frac{1}{2}$	$7\frac{1}{3}$	$\frac{4}{5}$
2.	$\frac{9}{10}$	$\frac{2}{3}$	$\frac{5}{6}$	$9\frac{7}{8}$	$8\frac{3}{4}$	$2\frac{1}{2}$	$15\frac{1}{8}$
	$\frac{3}{5}$	$\frac{1}{4}$	$\frac{3}{4}$	$1\frac{2}{3}$	$\frac{1}{6}$	$\frac{2}{5}$	$9\frac{1}{6}$
3.	6	5	1	$2\frac{1}{2}$	$1\frac{1}{8}$	$8\frac{1}{3}$	$13\frac{1}{2}$
	$4\frac{3}{4}$	$4\frac{2}{3}$	$\frac{5}{8}$	$1\frac{3}{4}$	$\frac{3}{4}$	$7\frac{5}{6}$	$7\frac{8}{9}$
4.	$7\frac{2}{3}$	$9\frac{1}{4}$	$9\frac{1}{2}$	$6\frac{2}{3}$	$10\frac{1}{4}$	$11\frac{1}{3}$	$16\frac{1}{5}$
	$1\frac{3}{4}$	$4\frac{5}{6}$	$7\frac{4}{5}$	$1\frac{7}{8}$	$\frac{7}{8}$	$4\frac{5}{8}$	$9\frac{7}{10}$

Changing Units of Measure

Find the missing numbers below.

27

	a	b	c
1.	12 yd. = ? ft.	18 gal. = ? qt.	7 ft. = ? in.
2.	27 oz. = ? lb.	36 fl.oz. = ? pt.	45 min. = ? hr.
3.	50 sec. = ? min.	85 min. = ? hr.	2 da. = ? hr.
4.	57 in. = ? ft.	$1\frac{1}{2}$ tons = ? lb.	$1\frac{3}{4}$ lb. = ? oz.
5.	$2\frac{1}{3}$ yd. = ? ft.	7 gal. = ? qt.	31 qt. = ? gal.
6.	$\frac{3}{4}$ yd. = ? in.	$\frac{7}{8}$ mi. = ? ft.	240 rd. = ? mi.
7.	440 yd. = ? mi.	80 rd. = ? mi.	5000 lb. = ? tons
8.	$1\frac{1}{2}$ pt. = ? fl.oz.	$2\frac{3}{4}$ lb. = ? oz.	$1\frac{1}{4}$ hr. = ? min.
9.	$\frac{4}{5}$ hr. = ? min.	72 sec. = ? min.	100 min. = ? hr.
10.	1 mi. = ? yd.	10 rd. = ? ft.	$\frac{1}{4}$ mi. = ? ft.

Addition and Subtraction of Measures

28

1.	4 lb. 8 oz. 3 lb. 9 oz. 1 lb. 4 oz.	4 qt. 1 pt. 5 qt. 2 qt. 1 pt.	23 min. 12 sec. 9 min. 45 sec. 56 sec.
2.	14 ft. 8 in. −9 ft. 6 in.	3 bu. 1 pk. −2 bu. 3 pk.	9 gal. 1 qt. −4 gal. 3 qt.
3.	7 hr. 18 min. 4 hr. 29 min. 1 hr. 40 min.	2 pt. 12 fl.oz. 4 pt. 8 fl.oz. 15 fl.oz.	6 yd. 18 in. 1 yd. 27 in. 33 in.
4.	14 ft. 2 in. −8 ft. 10 in.	9 hr. 12 min. −8 hr. 54 min.	23 min. 18 sec. −17 min. 25 sec.
5.	8 lb. 7 oz. 14 oz. 3 lb. 9 oz.	14 ft. 11 in. 1 ft. 8 in. 5 ft. 6 in.	3 da. 18 hr. 1 da. 11 hr. 16 hr.
6.	8 yd. 11 in. −1 yd. 24 in.	24 yr. −18 yr. 7 mo.	5 lb. 9 oz. −1 lb. 14 oz.

Multiplication of Fractions

29

	a	b	c	d
1.	$\frac{3}{8}\times 12=$	$\frac{5}{6}$ of $45=$	$9\times\frac{3}{8}=$	$1\frac{1}{2}\times\frac{3}{4}=$
2.	$\frac{5}{6}\times\frac{7}{10}=$	$\frac{2}{3}\times\frac{3}{4}=$	$\frac{8}{9}\times\frac{5}{6}=$	$2\frac{1}{4}\times 1\frac{1}{2}=$
3.	$\frac{3}{4}\times 2\frac{2}{3}=$	$\frac{5}{8}\times\frac{2}{3}\times\frac{4}{5}=$	$1\frac{1}{3}\times 2\frac{1}{4}=$	$\frac{9}{16}\times\frac{8}{9}=$
4.	$4\times\frac{2}{3}\times\frac{1}{2}=$	$6\times\frac{3}{4}\times\frac{1}{2}=$	$1\frac{1}{2}\times 8\frac{1}{4}=$	$\frac{5}{6}\times\frac{7}{8}\times\frac{2}{3}=$
5.	$\frac{2}{3}\times 1\frac{1}{2}\times 4=$	$\frac{4}{5}\times 3\times\frac{5}{6}=$	$2\frac{1}{2}\times\frac{1}{4}\times 1\frac{1}{3}=$	$\frac{1}{2}\times\frac{1}{3}\times\frac{3}{4}=$
6.	$12\times\frac{3}{4}\times 9=$	$\frac{5}{6}\times\frac{1}{2}\times\frac{9}{10}=$	$\frac{4}{5}\times\frac{2}{3}\times 10=$	$\frac{2}{3}\times 1\frac{1}{2}\times 1\frac{2}{3}=$
7.	$7\frac{2}{3}\times\frac{5}{6}=$	$1\frac{1}{2}\times\frac{3}{4}\times 2\frac{1}{2}=$	$\frac{5}{6}\times 3\frac{1}{7}\times\frac{1}{2}=$	$\frac{9}{16}\times\frac{11}{12}=$
8.	$40\times\frac{3}{8}=$	$\frac{9}{16}$ of $54=$	$1\frac{3}{8}\times 4\times 2\frac{1}{3}=$	$7\times 3\frac{1}{7}\times\frac{1}{2}=$
9.	$26\times 8\frac{3}{4}$	$15\times 6\frac{2}{3}$	$74\times 5\frac{3}{8}$	$47\times 8\frac{2}{3}$
10.	$87\frac{1}{2}\times 16$	$56\frac{2}{3}\times 9$	$105\frac{1}{2}\times 16$	$\$1.29\frac{1}{2}\times 48$

Division of Fractions

34

	a	b	c	d	e
1.	$6\div\frac{2}{3}=$	$11\div\frac{3}{4}=$	$1\div\frac{5}{6}=$	$9\div\frac{4}{5}=$	$2\div\frac{4}{9}=$
2.	$\frac{3}{4}\div 2=$	$\frac{5}{8}\div 4=$	$\frac{6}{7}\div 4=$	$\frac{8}{9}\div 2=$	$\frac{11}{12}\div 2=$
3.	$1\frac{1}{2}\div 3=$	$3\div 1\frac{1}{2}=$	$\frac{7}{8}\div 1\frac{1}{4}=$	$2\frac{1}{2}\div 3=$	$8\frac{1}{4}\div 4=$
4.	$1\frac{1}{16}\div 2=$	$1\div 1\frac{1}{2}=$	$2\div 3\frac{1}{4}=$	$8\frac{1}{2}\div 4\frac{1}{4}=$	$1\div\frac{5}{6}=$
5.	$\frac{2}{3}\div\frac{3}{4}=$	$\frac{3}{4}\div\frac{2}{3}=$	$\frac{5}{6}\div\frac{5}{8}=$	$\frac{11}{12}\div\frac{3}{4}=$	$\frac{3}{4}\div\frac{11}{12}=$
6.	$8\div\frac{2}{3}=$	$\frac{3}{4}\div 6=$	$4\frac{1}{2}\div 3=$	$3\div 4\frac{1}{2}=$	$\frac{7}{8}\div\frac{7}{10}=$
7.	$1\frac{1}{2}\div\frac{3}{8}=$	$8\frac{1}{2}\div 5\frac{1}{4}=$	$\frac{9}{16}\div\frac{3}{8}=$	$\frac{1}{12}\div\frac{1}{2}=$	$\frac{1}{2}\div\frac{1}{12}=$
8.	$1\div\frac{8}{9}=$	$11\div\frac{1}{2}=$	$\frac{5}{16}\div\frac{5}{8}=$	$\frac{5}{8}\div\frac{5}{16}=$	$7\div\frac{2}{3}=$
9.	$2\frac{1}{4}\div 2=$	$8\frac{1}{3}\div 2=$	$4\div 1\frac{1}{3}=$	$12\div 1\frac{1}{2}=$	$72\div\frac{8}{9}=$
10.	$5\div 6=$	$10\div 4=$	$15\div 24=$	$36\div 24=$	$72\div 80=$
11.	$5\frac{4}{9}\div 7=$	$7\div 5\frac{4}{9}=$	$3\frac{1}{2}\div 4=$	$2\div\frac{11}{12}=$	$1\frac{1}{2}\div\frac{3}{4}=$
12.	$14\div 35=$	$\frac{2}{3}\div 8=$	$2\frac{1}{3}\div 1\frac{3}{8}=$	$9\div 6=$	$\frac{4}{5}\div\frac{8}{15}=$

Finding the Ratio of Two Quantities

Find the ratio of **a** to **b** in the following:

36

	a	b		a	b		a	b
1.	1 pt.	2 qt.	11.	1 min.	30 sec.	21.	1 gal.	3 qt.
2.	10 min.	1 hr.	12.	45 sec.	1 min.	22.	5 qt.	1 gal.
3.	1 hr.	12 min.	13.	3 lb.	2 lb.	23.	120 sec.	1 min.
4.	2 ft.	18 in.	14.	1 lb.	8 oz.	24.	6 ft.	1 yd.
5.	15 in.	1 ft.	15.	1 bu.	3 pk.	25.	\$1	50¢
6.	1¢	\$1	16.	1 yd.	2 ft.	26.	1 qt.	40 fl.oz.
7.	25¢	\$1	17.	27 in.	1 yd.	27.	880 yd.	1 mi.
8.	25¢	10¢	18.	50 min.	1 hr.	28.	40 rd.	1 mi.
9.	1 lb.	14 oz.	19.	2 hr.	75 min.	29.	3 bu.	10 pk.
10.	12 oz.	1 lb.	20.	80 min.	1 hr.	30.	$\frac{1}{2}$ gal.	2 qt.

Finding a Number When a Fractional Part of It Is Given

Find the missing numbers in the following:

37

	a	b	c
1.	$\frac{3}{4}$ of ? = 60	$\frac{2}{3}$ of ? = 40	$\frac{5}{6}$ of ? = 70
2.	$\frac{7}{8}$ of ? = 35	$\frac{9}{10}$ of ? = 36	$\frac{11}{12}$ of ? = 66
3.	$\frac{8}{9}$ of ? = 72	56 = $\frac{7}{8}$ of ?	35 = $\frac{2}{3}$ of ?
4.	60 = $\frac{6}{7}$ of ?	20 = $\frac{3}{4}$ of ?	1 = $\frac{5}{6}$ of ?
5.	$\frac{2}{5}$ of ? = 45	$\frac{5}{6}$ of ? = 30	$\frac{4}{9}$ of ? = 46
6.	$\frac{11}{12}$ of ? = 40	$\frac{7}{10}$ of ? = 90	16 = $\frac{3}{8}$ of ?
7.	8 bu. = $\frac{2}{3}$ of ?	\$4.50 = $\frac{3}{8}$ of ?	\$75 = $\frac{3}{4}$ of ?
8.	15 min. = $\frac{2}{3}$ of ?	12 hr. = $\frac{3}{4}$ of ?	\$100 = $\frac{2}{3}$ of ?
9.	14 oz. = $\frac{4}{5}$ of ?	$\frac{5}{8}$ of ? = 20 hr.	$\frac{1}{9}$ of ? = 10¢
10.	750 gal. = $\frac{3}{4}$ of ?	450 mi. = $\frac{3}{4}$ of ?	$1\frac{1}{2}$ in. = $\frac{3}{8}$ of ?
11.	240 rd. = $\frac{3}{4}$ of ?	$\frac{7}{9}$ of ? = 84	42 = $\frac{5}{6}$ of ?
12.	9 hr. = $\frac{3}{8}$ of ?	50 sec. = $\frac{5}{6}$ of ?	$\frac{2}{7}$ of ? = 18

Multiplication and Division of Measurements

38

	a	b	c	d
1.	4 lb. 9 oz. ×3	6 ft. 8 in. ×4	1 yd. 15 in. ×3	2 lb. 8 fl. oz. ×4
2.	36 min. 15 sec. ×4	4 hr. 25 min. ×3	5 gal. 3 qt. ×4	16 min. 24 sec. ×5
3.	2)9 ft. 4 in.	3)8 bu. 2 pk.	4)6 gal. 2 qt.	5)42 min. 25 sec.
4.	3)7 yd. 18 in.	4)9 lb. 4 oz.	4)2 qt. 8 fl.oz.	6)32 min. 45 sec.
5.	2)3 hr. 20 min.	2)1 qt. 1 pt.	3)11 lb. 6 oz.	4)8 rd. 14 ft.
6.	2 hr. 17 min. ×4	9 lb. 8 oz. ×3	6 yd. 15 in. ×4	10 pt. 8 fl. oz. ×4
7.	3)45° 30′	4)72° 18′	2)1 yd. 24 in.	5)4 hr. 50 min.

Addition and Subtraction of Decimals

48

	a	b	c	d	e	f
1.	.4	4.8	.75	.90	2.74	.475
	.8	9.3	.48	.35	9.36	.258
	.9	0.5	.36	.46	5.87	.963
	.5	1.6	.27	.89	1.93	.445
2.	.47	1.02	7.25	.435	5.47	.725
	.52	3.05	4.58	.096	1.38	.864
	.96	9.08	0.93	.275	2.95	.329
	.38	6.05	1.76	.934	1.46	.062
3.	.75	.96	7.25	.645	.225	.041
	−.24	−.36	−1.46	−.638	−.219	−.037
4.	9.62	.441	7.00	.825	.406	.255
	−8.75	−.385	−1.56	−.775	−.398	−.249

Addition and Subtraction of Decimals—Continued

48

5. $.6 + .8 + .35 + .75 =$
6. $1.2 + 3.85 + 2.74 + .6 =$
7. $5 + 5.8 + 1.7 + 3 =$
8. $1.4 + .25 + 3.7 + 5.9 =$
9. $.4 + .7 + .85 + .53 =$
10. $7.1 + 2.4 + 3.05 + 0.98 =$
11. $7 - 3.5 =$
12. $15.1 - 2.84 =$
13. $3 - 1.62 =$

Multiplication of Decimals

62

	a	b	c	d	e
1.	73 × .8	1.49 × 5	3.4 × 1.8	.75 × .6	4.56 × 1.5
2.	9.6 × 24	.75 × 2.5	1.09 × 3.4	.025 × 3.4	4.25 × .06
3.	.3 × .3	72.5 × 3.4	40.5 × 8.6	.014 × 35	1.25 × 40

4. $10 \times 7.5 =$
5. $100 \times .58 =$
6. $1000 \times 3.14 =$
7. $100 \times .056 =$
8. $100 \times .025 =$
9. $100 \times .476 =$

Division of Decimals

71

	a	b	c	d	e
A. 1.	$5\overline{).6}$	$8\overline{)3.4}$	$4\overline{)1.8}$	$7\overline{)1.4}$	$9\overline{).45}$
2.	$6\overline{).3}$	$5\overline{).17}$	$2\overline{).51}$	$4\overline{).7}$	$8\overline{)13.6}$
3.	$14\overline{).21}$	$12\overline{).9}$	$18\overline{)47.7}$	$25\overline{)7.15}$	$20\overline{)3.7}$
4.	$50\overline{)1.4}$	$20\overline{)7.8}$	$25\overline{).96}$	$16\overline{)8}$	$40\overline{)37.5}$
B. 1.	$4\overline{)5}$	$8\overline{)15}$	$6\overline{)15}$	$4\overline{)13}$	$12\overline{)9}$
2.	$5\overline{)7}$	$5\overline{)4}$	$16\overline{)9}$	$18\overline{)45}$	$25\overline{)4}$

	a	b	c	d	e
3.	$20\overline{)7}$	$50\overline{)11}$	$14\overline{)35}$	$36\overline{)27}$	$24\overline{)18}$

71

Find the value to the nearest hundredth:

4.	$6\overline{)5}$	$3\overline{)2}$	$9\overline{)7}$	$11\overline{)9}$	$16\overline{)15}$
5.	$7\overline{)16}$	$12\overline{)13}$	$13\overline{)20}$	$15\overline{)13}$	$24\overline{)19}$
C. 1.	$.4\overline{)12}$	$.2\overline{)5}$	$.03\overline{)15}$	$.7\overline{)42}$	$.8\overline{)15}$
2.	$.5\overline{)9}$	$.4\overline{)7}$	$2.5\overline{)16}$	$1.2\overline{)9}$	$1.6\overline{)9}$
3.	$.04\overline{)1}$	$.5\overline{)8}$	$3.6\overline{)18}$	$.75\overline{)3}$	$12.5\overline{)8}$
4.	$1.5\overline{)9}$	$1.6\overline{)264}$	$2.5\overline{)2}$	$.12\overline{)15}$	$.08\overline{)1}$
D. 1.	$.3\overline{).48}$	$.9\overline{)8.1}$	$.5\overline{).07}$	$.4\overline{).13}$	$.02\overline{)1.7}$
2.	$.25\overline{).4}$	$1.6\overline{)8.4}$	$1.5\overline{).6}$	$.75\overline{).6}$	$.25\overline{).1}$
3.	$1.4\overline{).35}$	$1.8\overline{).72}$	$3.6\overline{).72}$	$.25\overline{)1.7}$	$.11\overline{).88}$
4.	$3.2\overline{).672}$	$3.5\overline{).28}$	$.16\overline{).912}$	$.26\overline{)148.2}$	$2.7\overline{)12.96}$

Changing Metric Measures

	a	b	c
1.	36 cm. = ? mm.	4.5 km. = ? cm.	1.85 km. = ? mm.
2.	850 mm. = ? cm.	850 mm. = ? km.	1250 mm. = ? km.
3.	960 mm. = ? km.	960 mm. = ? cm.	960 cm. = ? km.
4.	4.275 km. = ? mm.	4.275 km. = ? cm.	1 km. = ? mm.
5.	2.8 cm. = ? mm.	1.5 mm. = ? cm.	3 m. = ? cm.
6.	7.2 km. = ? m.	75 m. = ? km.	75 m. = ? cm.
7.	1.9 m. = ? cm.	2.54 mm. = ? cm.	39.37 cm. = ? mm.
8.	438 mm. = ? cm.	4.38 cm. = ? mm.	4.38 m. = ? mm.

78

Finding a Per Cent of a Number

92 Find the missing numbers:

	a	b	c
1.	12% of 75 = ?	16% of 120 = ?	15% of 84 = ?
2.	25% of 52 = ?	$33\frac{1}{3}$% of 180 = ?	50% of 145 = ?
3.	75% of 96 = ?	$66\frac{2}{3}$% of 450 = ?	$37\frac{1}{2}$% of 800 = ?
4.	2.4% of 57 = ?	1.5% of 160 = ?	3.4% of 260 = ?
5.	$33\frac{1}{3}$% of 210 = ?	2.7% of 420 = ?	$2\frac{1}{2}$% of 480 = ?
6.	35% of 360 = ?	11% of 290 = ?	7% of 145 = ?
7.	2.8% of 940 = ?	$3\frac{1}{2}$% of 750 = ?	1.6% of 440 = ?
8.	5% of 37.5 = ?	2% of 19.8 = ?	3.5% of 47.5 = ?
9.	40% of 77.5 = ?	10% of 4.5 = ?	100% of 3.8 = ?
10.	$66\frac{2}{3}$% of 510 = ?	75% of 960 = ?	$62\frac{1}{2}$% of 640 = ?

Per Cents Greater than 100%

101 1. Express as per cents:

a. 1.4	c. 4	e. 2	g. 1.025	i. 6
b. 2.2	d. 1.75	f. 3.25	h. 3.075	j. 2.9

2. Express in decimal form:

a. 425%	c. 400%	e. 200%	g. $102\frac{1}{2}$%
b. 120%	d. 720%	f. 103%	h. $133\frac{1}{3}$%

Find the missing numbers:

	a	b	c
3.	150% of 46 = ?	200% of 83 = ?	120% of 430 = ?
4.	$133\frac{1}{3}$% of 270 = ?	110% of 68 = ?	102% of 720 = ?
5.	36 = ?% of 25	23 = ?% of 20	450 = ?% of 300
6.	114 = ?% of 100	75 = ?% of 50	75 = ?% of 60
7.	103% of 840 = ?	960 = ?% of 720	225% of 160 = ?
8.	119 = ?% of 50	57 = ?% of 50	180 = ?% of 150
9.	102% of 940 = ?	90 = ?% of 75	102.5% of 1450 = ?
10.	225% of 460 = ?	102.4% of 1200 = ?	101.4% of 1740 = ?

Finding a Fractional Per Cent of a Number

102

	a	b	c
1.	$\frac{1}{2}\%$ of 720 =	$\frac{1}{3}\%$ of 1200 =	$\frac{3}{4}\%$ of 840 =
2.	$\frac{1}{4}\%$ of 1000 =	$\frac{1}{5}\%$ of 1500 =	$\frac{1}{8}\%$ of 2000 =
3.	$\frac{1}{2}\%$ of 10,000 =	$\frac{2}{3}\%$ of 30,000 =	$\frac{5}{8}\%$ of 40,000 =
4.	.1% of 800 =	.4% of 1600 =	.5% of 7500 =
5.	$\frac{1}{12}\%$ of 75,000 =	$\frac{1}{12}\%$ of 96,000 =	.1% of 60,000 =
6.	$\frac{1}{4}\%$ of 7200 =	$\frac{1}{2}\%$ of 9200 =	.2% of 50,000 =

Finding Per Cent of Change

105

Find the per cent of change when the change is:

1.	From 50 to 40	From 50 to 60	From 150 to 100
2.	From 75 to 100	From 90 to 75	From 75 to 90
3.	From 150 to 125	From 125 to 150	From 150 to 175
4.	From 40 to 32	From 32 to 40	From 64 to 72
5.	From 250 to 270	From 250 to 235	From 200 to 187
6.	From 500 to 620	From 500 to 430	From 600 to 520
7.	From 400 to 450	From 450 to 400	From 450 to 500
8.	From $\frac{1}{2}$ to $\frac{1}{4}$	From $\frac{1}{2}$ to $\frac{3}{4}$	From $\frac{1}{2}$ to 1

Finding a Number When a Per Cent of It Is Given

108

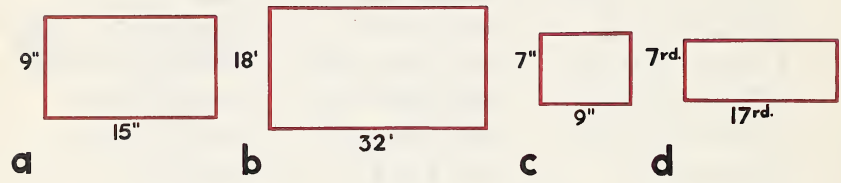
1.	30 = 6% of ?	50 = 2% of ?	75 = 25% of ?
2.	8% of ? = 40	9% of ? = 45	3% of ? = 18
3.	120% of ? = 60	125% of ? = 75	150% of ? = 30
4.	18 = 200% of ?	160 = 40% of ?	17 = 10% of ?
5.	9 = 1% of ?	6.4 = 2% of ?	150 = 15% of ?
6.	2.5% of ? = 40	1.5% of ? = 30	3.4% of ? = 17
7.	300% of ? = 450	110% of ? = 55	90% of ? = 630
8.	4% of ? = 18	24 = 16% of ?	30 = 25% of ?
9.	.5% of ? = 10	.4% of ? = 8	.3% of ? = 12
10.	1% of ? = 6.7	2% of ? = 9.5	4% of ? = 9.6

Finding Perimeters and Areas of Rectangles

Find the missing numbers in the following:

	Length	Width	Perimeter	Area		Length	Width	Perimeter	Area
130 1.	14 ft.	9 ft.	?	?	8.	12.5 ft.	9.2 ft.	?	?
2.	16 in.	11 in.	?	?	9.	$5\frac{1}{2}$ in.	$3\frac{3}{4}$ in.	?	?
3.	24 cm.	18 cm.	?	?	10.	45 cm.	27 cm.	?	?
4.	4.6 m.	2.5 m.	?	?	11.	1.2 km.	0.8 km.	?	?
5.	5.5 yd.	3.5 yd.	?	?	12.	3.6 m.	2.3 m.	?	?
6.	$\frac{1}{2}$ mi.	$\frac{3}{8}$ mi.	?	?	13.	$9\frac{3}{4}$ ft.	$6\frac{1}{2}$ ft.	?	?
7.	4 rd.	2.5 rd.	?	?	14.	52 cm.	38 cm.	?	?

15. Find the perimeter and area of each of the following:



Finding the Third Angle of a Triangle

Angles A, B, and C are the angles of a triangle. Find the missing numbers in the table.

	A	B	C		A	B	C
143 1.	46°	52°	?	8.	60°	25°	?
2.	90°	34°	?	9.	58°	?	46°
3.	?	75°	75°	10.	107°	34°	?
4.	?	48°	35°	11.	90°	60°	?
5.	19°	?	56°	12.	40° 30′	60° 30′	?
6.	48°	?	77°	13.	?	52° 40′	80° 20′
7.	25°	?	103°	14.	35° 25′	67° 10′	?

Finding the Area of a Trapezoid

Find the area of trapezoids having the following dimensions:

	Altitude	Upper Base	Lower Base
1.	14 in.	16 in.	24 in.
2.	9 ft.	45 ft.	28 ft.
3.	36 cm.	52 cm.	75 cm.
4.	7 m.	23 m.	14 m.
5.	5 yd.	2 yd.	$4\frac{1}{2}$ yd.
6.	16 in.	32 in.	15 in.
7.	4 ft.	$7\frac{1}{2}$ ft.	12 ft.
8.	5 in.	11 in.	16 in.
9.	55 cm.	45 cm.	55 cm.
10.	3 m.	4.5 m.	6.4 m.
11.	27 ft.	14 ft.	24 ft.
12.	6 yd.	17 yd.	9 yd.
13.	2.6 m.	10.5 m.	18.4 m.
14.	8 ft.	$12\frac{1}{2}$ ft.	21 ft.

147

Finding Area and Circumference of a Circle

Find the missing numbers in the following:

	(Use $\pi = 3.14$) d	A	C	(Use $\pi = 3\frac{1}{7}$) r	A	C
1.	8 ft.	?	?	7. 14 in.	?	?
2.	40 cm.	?	?	8. 21 cm.	?	?
3.	24 in.	?	?	9. 3.5 m.	?	?
4.	5 m.	?	?	10. $1\frac{3}{4}$ mi.	?	?
5.	3.4 mi.	?	?	11. 28 ft.	?	?
6.	8.6 ft.	?	?	12. 35 cm.	?	?

153

Finding Interest on Loans

To the nearest cent, find the interest on the following:

	Principal	Rate	Time	Principal	Rate	Time
1.	$450	5%	$\frac{1}{2}$ yr.	7. $600	5%	30 da.
2.	$950	4%	$1\frac{1}{2}$ yr.	8. $750	5%	45 da.
3.	$300	6%	90 da.	9. $800	$4\frac{1}{2}$%	72 da.
4.	$750	5%	60 da.	10. $1250	4%	36 da.
5.	$250	6%	45 da.	11. $550	6%	45 da.
6.	$600	$4\frac{1}{2}$%	90 da.	12. $900	5%	75 da.

167

Discounting a Note

171 Find the bank discount and the proceeds on the following loans:

	Principal	Rate	Time		Principal	Rate	Time
1.	$600	5%	30 da.	9.	$100	6%	60 da.
2.	$200	6%	60 da.	10.	$250	6%	30 da.
3.	$720	5%	90 da.	11.	$750	5%	60 da.
4.	$800	$4\frac{1}{2}$%	45 da.	12.	$500	4%	90 da.
5.	$1200	5%	120 da.	13.	$1200	$4\frac{1}{2}$%	60 da.
6.	$450	6%	30 da.	14.	$2500	5%	45 da.
7.	$1000	4%	72 da.	15.	$3000	4%	30 da.
8.	$960	$4\frac{1}{2}$%	60 da.	16.	$1750	6%	30 da.

Practising with Per Cents

203 1. Express as per cents:

a. .7	d. $1\frac{1}{4}$	g. 2.01	j. 1	m. 1.015
b. .12	e. $1\frac{1}{3}$	h. 2.3	k. 3.2	n. .0225
c. 1.03	f. $\frac{7}{8}$	i. .025	l. 1.6	o. 2.03

2. Express in decimal form:

a. 42%	d. 120%	g. 2.5%	j. 3%	m. 220%
b. 102%	e. 300%	h. 1.25%	k. 1.8%	n. 105%
c. 5.4%	f. 6%	i. 150%	l. .5%	o. 40%

3. Find the missing numbers in the following:

a. 3% of 750 = ?	g. 7 = ?% of 50	m. 50 = 2% of ?
b. 16% of 420 = ?	h. 18 = ?% of 25	n. 8 = $33\frac{1}{3}$% of ?
c. 102% of 800 = ?	i. 39 = ?% of 20	o. 3% of ? = 120
d. 200% of 180 = ?	j. 120 = ?% of 80	p. 150% of ? = 90
e. 2.5% of 650 = ?	k. 1 = ?% of 200	q. 200% of ? = 14
f. $\frac{1}{4}$% of 780 = ?	l. 160 = ?% of 150	r. 125% of ? = 120

Finding the Volume of Rectangular Prisms

Find the missing numbers in the following:

	Length	Width	Height	Area of Base	Volume of Prism
1.	9 ft.	2 ft.	6 ft.	?	?
2.	16 in.	5 in.	12 in.	?	?
3.	55 cm.	18 cm.	45 cm.	?	?
4.	2.5 m.	.6 m.	1.4 m.	?	?
5.	27 in.	8 in.	42 in.	?	?
6.	75 cm.	24 cm.	35 cm.	?	?
7.	15 ft.	?	10 ft.	75 sq. ft.	?
8.	18 in.	?	15 in.	90 sq. in.	?
9.	?	2 ft.	5 ft.	6 sq. ft.	?
10.	?	20 cm.	38 cm.	600 sq. cm.	?
11.			4.6 m.	76.5 sq. m.	?
12.			$8\frac{1}{2}$ ft.	670 sq. ft.	?
13.	$2\frac{3}{4}$ ft.	$\frac{1}{2}$ ft.	$1\frac{1}{2}$ ft.	?	?

Area and Volume of a Cylinder

Find the missing numbers. Use $\pi = 3.14$ in examples 1–5 and $\pi = 3\frac{1}{7}$ in examples 6–10.

	Diameter	Radius	Height	Lateral Area	Volume
1.	16 in.	?	9 in.	?	?
2.	24 cm.	?	45 cm.	?	?
3.	5 ft.	?	12 ft.	?	?
4.	32 ft.	?	18 ft.	?	?
5.	1.8 m.	?	2.6 m.	?	?
6.	28 in.	?	48 in.	?	?
7.	?	$3\frac{1}{2}$ ft.	25 ft.	?	?
8.	?	7 ft.	32 ft.	?	?
9.	?	42 cm.	120 cm.	?	?
10.	?	35 in.	66 in.	?	?

Finding Property Tax

294

Find the tax on the following:

	Assessed Valuation	Tax Rate		Assessed Valuation	Tax Rate
1.	$4500	3.80%	8.	$10,400	$3.92 on $100
2.	$7200	4.16%	9.	$15,600	$4.29 on $100
3.	$5550	4.73%	10.	$11,450	$5.10 on $100
4.	$8250	3.95%	11.	$14,750	39.8 mills
5.	$6150	5.17%	12.	$17,000	52.3 mills
6.	$4900	4.78%	13.	$25,400	38.9 mills
7.	$6500	4.07%	14.	$45,000	40.7 mills

Finding the Ratio of Two Numbers

313

Find the ratio in each of the following:

	a	b	c	d
1.	10 to 25	14 to 16	7 to 7	11 to 22
2.	15 to 10	13 to 39	25 to 20	14 to 7
3.	25 to 45	60 to 50	100 to 120	120 to 100
4.	10 to 4	8 to 20	25 to 40	40 to 25
5.	16 to 24	36 to 64	72 to 64	90 to 60
6.	100 to 150	150 to 125	250 to 225	225 to 250
7.	45 to 75	75 to 45	100 to 175	300 to 150
8.	50 to 80	80 to 50	40 to 90	120 to 80

9. Find the ratio of **a** to **b** in each of the following:

I

a

b

II

a

b

Solving Equations

Solve and check each of the following equations:

		a	b	c	d
I	1.	$5x = 60$	$3x = 72$	$9x = 144$	$7x = 147$
	2.	$4x = 84$	$5a = 80$	$6b = 54$	$3y = 72$
	3.	$2r = 55$	$3a = 84$	$7c = 98$	$9k = 108$
	4.	$8x = 420$	$5y = 135$	$2z = 63$	$6n = 90$
	5.	$9n = 360$	$72 = 4n$	$1.8 = 2x$	$.6 = 3n$
	6.	$4a = 9.2$	$5r = 6.8$	$3b = 5.1$	$8y = 12.4$
II	1.	$\frac{n}{2} = 11$	$\frac{n}{5} = 9$	$\frac{x}{8} = 14$	$\frac{p}{5} = 7$
	2.	$\frac{x}{8} = 9$	$\frac{n}{3} = 17$	$\frac{p}{4} = 38$	$\frac{n}{7} = 19$
	3.	$\frac{x}{2} = 3\frac{1}{2}$	$\frac{y}{3} = 3.5$	$\frac{t}{4} = 9\frac{1}{4}$	$\frac{n}{2} = 7\frac{1}{2}$
	4.	$26 = \frac{n}{5}$	$1.2 = \frac{x}{5}$	$7.8 = \frac{z}{2}$	$20 = \frac{n}{9}$
	5.	$\frac{x}{4} = 7.5$	$\frac{y}{5} = 13.6$	$\frac{z}{2} = 11.5$	$\frac{a}{12} = 1.5$
	6.	$\frac{n}{18} = 1\frac{1}{2}$	$\frac{p}{4} = 26\frac{3}{4}$	$\frac{a}{15} = 7.4$	$\frac{n}{3} = 145$
III	1.	$x - 4 = 15$	$n - 1 = 8$	$n - 6 = 0$	$x - 5 = 4$
	2.	$n - 3 = 21$	$n - 18 = 18$	$a - 17 = 50$	$b - 14 = 36$
	3.	$y - 15 = 29$	$y - 16 = 43$	$b - 54 = 39$	$a - 17 = 48$
	4.	$n - \frac{1}{2} = \frac{1}{4}$	$n - \frac{3}{4} = 1\frac{1}{4}$	$x - \frac{1}{2} = \frac{1}{3}$	$n - \frac{3}{4} = \frac{7}{8}$
	5.	$a - \frac{2}{3} = \frac{5}{6}$	$b - \frac{7}{8} = 1\frac{1}{2}$	$x - 1.4 = 3.2$	$n - .6 = 1.9$
	6.	$n - 2.9 = 0$	$n - 5 = 4.2$	$y - \frac{3}{8} = \frac{1}{2}$	$n - \frac{2}{3} = \frac{3}{4}$
IV	1.	$x + 1 = 5$	$x + 9 = 27$	$n + 17 = 30$	$n + 25 = 41$
	2.	$x + 19 = 24$	$x + 58 = 64$	$x + 36 = 53$	$n + 21 = 38$
	3.	$x + 17 = 17$	$x + 25 = 71$	$x + 18 = 40$	$a + 15 = 23$
	4.	$x + \frac{1}{2} = \frac{3}{4}$	$x + \frac{1}{3} = \frac{5}{6}$	$x + \frac{1}{2} = 1\frac{1}{4}$	$n + \frac{2}{3} = 1\frac{1}{2}$
	5.	$x + .6 = 1$	$n + \frac{3}{4} = 2$	$n + 1.8 = 7.5$	$n + 5 = 6.5$
	6.	$a + \frac{1}{4} = \frac{1}{3}$	$a + \frac{5}{6} = 4$	$n + 2\frac{1}{4} = 3\frac{1}{2}$	$n + 7.8 = 10.2$

Vocabulary of Arithmetic

Define, illustrate, or use in a sentence each of the terms given below. The number in parentheses shows where the term is introduced.

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SET I

Altitude	(138)	Obtuse angle	(141)
Approximate Sq. Root	(336)	Par value of stock	(204)
Assessed valuation	(293)	Perfect square	(330)
Bond	(305)	Prism	(260)
Canada Savings Bond	(200)	Proceeds	(172)
Cylinder	(270)	Promissory note	(170)
Direct measurement	(320)	Property tax	(294)
Equation	(322)	Pyramid	(274)
Hypotenuse	(331)	Regular polygon	(233)
Income tax	(300)	Square root	(330)
Indirect measurement	(320)	Trapezoid	(146)
Lateral area	(272)	Volume	(262)

SET II

Bank discount	(172)	Isosceles triangle	(140)
Beneficiary	(218)	Kilogram	(80)
Bisector	(229)	Kilometer	(79)
Brokerage	(207)	Liability insurance	(214)
Centimeter	(78)	List price	(119)
Central angle	(155)	Longitude	(278)
Circumference	(149)	Meter	(78)
Congruent	(236)	Plane figure	(259)
Compound interest	(194)	Pentagon	(234)
Equilateral triangle	(140)	Polygon	(233)
Exponent	(129)	Premium (insurance)	(210)
Instalment buying	(178)	Symmetry	(238)
Interest formula	(166)	Time zones	(279)

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